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ABSTRACT

This research was designed to describe a constructivist science teacher education program and to investigate how students in the program experienced a constructivist learning environment. Nineteen students enrolled in a four-term program for prospective secondary science teachers participated in this one-year study. A rich description of the constructivist teacher education program established the context for the study. Three focus questions guided the study. They included: (1) What depth of understanding do the students possess and communicate about constructivism? (2) What was students' experience with constructivism in the internships? (3) What pedagogical strategies did the students describe that worked in their internships? Data were collected by means of questionnaires, on-line bulletin board writing, journals, and videotapes of class sessions. Results indicated that students developed a depth of understanding of constructivism even after their internships. Most interns were able to implement constructivism in their classrooms, although nearly 33% felt they would not be able to implement constructivism in their first year of teaching. Interns reported that cooperative learning, alternative assessments, and Internet activities worked best in their internship experiences. Attached to the document are printouts from the TEEMS science Web site, including syllabi, agenda, research projects, and research tools. (Contains 31 references.) (Author)

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Experiences in A Constructivist Community of Practice:

An Inquiry into TEEMS---A Science Teacher Education Program

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Note: This paper was presented at the Annual Meeting of the National Association for Research in Science Teaching, New Orleans, LA., April 29, 2000.

Introduction | Theoretical Framework | Questions | Method | The TEEMS Program | Results | Discussion | References

Abstract

This research was designed to describe a constructivist science teacher education program and investigate how students in the program experienced a constructivist learning environment. Nineteen students enrolled in a four-term program for prospective secondary science teachers participated in this one-year study. A rich description of the constructivist teacher education program established the context for the study. Three focus questions guided the study. They included 1). What depth of understanding do the students posses and communicate about constructivism. 2). What was students' experience with constructivism in their internships? 3). What pedagogical strategies did the students describe that worked in their internships? Data were collected by means of questionnaires, on-line bulletin board writing, journals, and videotapes of class sessions. Results indicated that students developed a depth of understanding of constructivism even after their internships. Most interns were able to implement constructivism in their classrooms, although nearly 33% felt they would not be able to implement constructivism in their first year of teaching. Interns reported that cooperative learning, alternative assessments, and Internet activities worked best in their internship experiences.

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Introduction

The purpose of this paper is to describe a constructivist science teacher education program (Teacher Education Environments in Mathematics and Science---TEEMS) and to explore how students in this program experienced a constructivist teacher education learning environment. The program is characterized as an inquiry-oriented and reflective thinking program which fosters a student-centered learning environment. In particular the students' conceptions of constructivism were explored to find out how the concept was understood and experienced, and whether students in the program felt the concept had practical relevance. To explore the practical relevance of the concept of constructivism data was collected on what students in the program thought worked and didn't work in their internship experiences. Links were made between these data and the data collected on students' conception of constructivism over the course of the program period.

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Theoretical Framework

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The theoretical framework for this study is embedded in the conversation about changing views of the pedagogy of teacher education. As Korthagen and Kessels (1999) point out, "The pressure towards more school-based teacher education programs, visible in many countries, creates the need to rethink the relationship between theory and practice (p.4)." As they point out, the traditional application-of-theory model appears to be ineffective and is being replaced by more reflective approaches.

Typically teacher education programs move from theory to practice, with education majors taking courses in a variety of departments that lack an integrated and holistic approach. The term "practice teacher" and indeed the term "student teaching" imply the "application of theory" model (Korthagen and Kessels, 1999). The underlying concept in the "application of theory" approach is that prospective teachers are taught a body of knowledge about teaching, and then apply (practice) this knowledge in school settings.

Zeichner (1983) identified four topologies of teacher education programs including 1) the behaviorist orientation, 2) psychological/ personalistic orientation, 3) the craft-oriented approach and 4) the inquiry-oriented approach. The inquiry-oriented approach is a student-centered model in which the student is seen as an active learner (Harmin, 1994). In teacher education the approach fosters a constructivist environment in which prospective teachers use inquiry strategies to learn pedagogical skills, explore the nature of student learning in the context of schools, and reflect on their own learning.

However, Imig and Switzer (1996) report that teacher education programs have been increasingly putting more emphasis on knowledge bases to teach to prospective teachers. This has led to education courses that emphasize expert-knowledge (Sprinthall, Reiman & Thies-Sprinthall, 1996) to be learned in the "application of theory" model. But as these researchers point out, many of the ideas presented as "expert-knowledge" are washed out during field experiences and the first years of teaching.

However, newer paradigms are emerging in teacher education that appear to mitigate against the results of the "application of theory" model. Korthagen and Kessels (1999, p. 6), summarizing the work of Calderhead (1989) describe the new paradigms in this way:

- "Many of these attempts can be characterized by an emphasis on reflective teaching, implying that teacher education is conceptualized as an ongoing process of experiencing practical teaching and learning situations, reflecting on them under the guidance of an expert, and developing one's own insights into teaching through the interaction between personal reflection and theoretical notions offered by the expert."

The social and psychological context for teacher education programs has been explored in the context of constructivism (Oldfather et al., 1994, Bell and Gilbert, 1996, and Tobin, Kahle, and Frasher, 1990). Using constructivism as a referent (Tobin and Fraser, 1990), learners explore pedagogy in an inquiry-oriented and active learning environment (Hassard, 1992).

Constructivism refers to the belief that human knowledge is constructed, and that it is constructed within human minds and within social communities (Richardson, 1999). In teacher education, the application of constructivism has recently been applied. Richardson (1999, pp. 152-153) describes the process of constructivist teacher education this way:

- "The process of a constructivist teacher education approach involves using constructivist methods of education of preservice and inservice teachers. A process focus attempts to create a constructivist environment in the teacher education

> classroom that includes using the pedagogical tools of dialogue, the development of meaningful tasks, and "giving reason" to the participants. These processes are often used by teacher educators to model how they want their students to eventually teach in their own classrooms."

Teacher education programs however must deal with the issue that Lortie (1975) refers to as the teacher socialization problem. According to Lortie, teacher socialization occurs while in the role of student teacher and that quite often prospective teachers are exposed to rather conservative approaches to teaching. Any alternative view to teaching is short-lived, even during student teaching.

An approach that offers an alternative to this outcome is described as "realistic teacher education (Korthagen and Kessels, 1999, p. 7). They describe this approach in the following ways:

- "To put it in its shortest form, the realistic approach goes from practice to theory. An interesting aspect is that the gap between theory and practice disappears, although it is better to say that it is not created by the educational process itself, as in the case in the traditional approach. In cognitive psychological terms one can say that the intended learning processes start from "situated knowledge", developed in the interaction of the learners with the problem situations, and that the concrete situations remain the reference points during the learning process."

For prospective teachers, a realistic teacher education program would be grounded in constructivism, and would be characterized as follows (Korthagen and Kessels, 1999, p. 7):

- "An approach more in line with Freudenthal's ideas about learning would take its starting point in real problems encountered by student teachers during field experiences. The student teacher would then develop his or her own knowledge in a process of reflection on the practical situations in which a personal need for learning was created. As in the case in realistic mathematics education, the emphasis shifts toward inquiry-oriented activities, interaction amongst learners, and the development of reflective skills."

Thus teacher education programs rooted in experience (Dewey, 1938) and experiential knowledge (Maslow, 1966) provide the context for learning in which prospective teachers, in an inquiry-oriented environment, develop knowledge about teaching rooted in "realistic education." The TEEMS program, which forms the context for this research, is built upon these ideas.

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Research Questions

The purpose of this study was to explore how students in the TEEMS program experienced a constructivist teacher education learning environment and how the approach impacted their ideas about teaching and learning in their internships. The following questions guided the research:

- What depth of understanding do TEEMS students posses and communicate about the concept of constructivism? How does their understanding compare and change at different points of their program?
- What was students' conception of the practical relevance of constructivism? To what extent did they think they could implement constructivist practices in their internships? And to what degree do they think they will be able to implement constructivism in their first year of teaching?

- What pedagogical strategies did TEEMS students describe that "worked" in the classroom during their internships? What pedagogies did they think they should "let go?" How did these pedagogies relate to their understanding of constructivism?

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Method

Context of the Research&endash;A Description of the TEEMS Program

Historical Perspective

TEEMS is a constructivist approach to science teacher education, and is based on an active-learning model, as well as nearly ten years of experience with alternative teacher preparation. The Department of Middle Secondary Education and Instructional Technology (MSIT) was the first department at Georgia State University (GSU) to provide alternative paths to the teaching profession (Hassard, Rawlings & Giesel, 1993). Starting in 1970 (Table 1), with the Science Education Phase Program (Phases) teacher education programs in science have been developed as well as alternative teacher education programs leading to teaching certificates were designed in foreign language, mathematics and science. Through cooperative efforts among GSU, the Georgia Professional Standards Commission and many school districts throughout the state, more than 80 teachers began teaching careers through the TRIPS Program, and the Alternative Teacher Preparation Program in Foreign Language, Mathematics and Science (Hassard, Rawlings & Giesel, 1993). Table 2 summarizes some of the key attributes of each of the programs leading up to and including TEEMS.

One of the outcomes of these alternative teacher preparation programs was to rethink the nature of teacher education, and to begin to visualize and plan for new approaches to teacher education. As a result of the convergence of our work in alternative teacher preparation, the apparent American national crisis in science and mathematics, and the emerging epistemology of constructivism (von Glassersfeld, 1992), a new program for the preparation of mathematics and science teachers was developed.

The underlying framework for the new program is constructivism, which suggests that human beings construct knowledge through acting on their environment and interacting with other humans. In practical terms we accepted the notion that students entering this new teacher education program would have preconceptions about how to teach and how they think children learn science. As Wahl, Weinert, & Huber (1984) report, these preconceptions are resistant to change using traditional methods. To deal with this within a new framework would

Table 1. Georgia State University Teacher Preparation Pedagogical Time Line - 1970 - 2001

Years	Pedagogical Period	Situative Environment	Content	N	Credentialing
1994 - 2001 6 yrs	TEEMS	Summer Institute f/b MS-HS Co-Teaching Internships Constructivist/Community of Practice/Authentic Activities 45 hrs	Science	129	M.Ed. & Teaching License, 7-12
1988 - 1993 4 yrs	ACI (Alternative Certification Institute)	Summer Institute f/b Funded HS Intern/Mentor Program Constructivist/Community of Practice/Authentic Activities 21 hrs	Science Math F Lang	72	Teaching License, 7 - 12
1986 - 1988 2 yrs	TRIPS (Teacher Recruitment & Intern Program System)	Summer Institute f/b Paid HS Intern/Mentor Program in Atlanta Public Schools Community of Practice/Authentic 21 hrs	Science Math F Lang	16	Teaching License, 7 - 12
1983 - 2000 17 yrs	Post-Bac	Coursework/methods courses/student teaching Concurrent with TRIPS, ACI & TEEMS (eliminate) Traditional/Separate Courses 30 hrs	Science	85	Teaching License, 7 - 12
1970 - 1983 14 yrs	Phases	Sequenced ES-MS-HS Integrated Internships & Coursework Experiential Learning & Humanistic Psychology Community of Practice 30 hrs	Science	112	Teaching License, 7 - 12

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Table 2. EMERGENCE OF TEEMS AS A SCIENCE TEACHER EDUCATION PROGRAM - 1970 - 2001

Attribute	The Phase Program	TRIPS	ACI	TEEMS
Years	1970 - 1983	1986-1988	1988 - 1993	1994 - 2001
Content Areas	Science	Foreign Language, Mathematics, Science	Foreign Language, Mathematics, Science	Science
Program Type & Structure	Post Baccalaureate (P.B.); Initial Preparation	P.B; Initial Preparation; Collaboration among APS, GSU, Atlanta U, & AFT	P.B; Initial Preparation, Funded by Professional Standards Commission (5 years---$500,000)	Masters Degree and Initial Preparation
Location of Learning Environment	GSU integrated with Elementary, Middle & Secondary classrooms	GSU/AU & AFT Summer Workshop integrated with Intern/Mentor Program in APS High School Classrooms	Summer Institute (Athens & then GSU) followed by Intern/Mentor Program in Georgia Middle and High School Classrooms	Summer Institute followed by integrated coursework and Intern/Mentor experiences in Metro-Atlanta Middle and High School Classrooms
Mentoring	Classroom teacher at the elementary (Fall), middle (Winter) and high school (Spring) No specific mentor training	High School Teacher in same content area as Intern; Full Year in Atlanta P.S. Mentor released 1 class for each Intern; Interns (hired by APS) taught reduced classload (4 classes instead of 5) 1 week Mentor education program with Interns	Middle or High School teacher in same content area; Full Year of mentoring with monthly seminars at GSU; Interns hired on provisional contract 1 week Mentor education program with Interns	Middle and High School teacher in content area of intern; Co-teaching and mentoring model; Interns paired with one mentor in Middle School Internship; one pair at HS this year
Admission Criteria	Major in or majoring in science; 2.5 GPA; Test scores; no interview	Degree in the content area; 2.5 GPA; Test Scores; Interviews	Degree in the content area; 2.5 GPA; Test Scores; Interviews	Degree in the content area; 2.5 GPA & Increasing (Ave: 3.1); GRE Test Scores (Ave. 1100;

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	(90% had degrees)			Interviews
Number of Students	~100	16	72	129
Assessment	Grades in Coursework, Journals; Portfolios; Artifacts; Mentors	Grades in Coursework and Mentors	Grades in Coursework, Journals; Portfolios; Artifacts; Mentors	Grades in Coursework, Journals; Portfolios; Artifacts; Mentors
Internet	----	----	----	Web-assisted using WebCt; Extensive Website; Tools for Reflection: message board, chat rooms, group-email; development of own websites;

mean the program design would be based on an experiential and active learning model in which students would work in collaborative groups on problem solving activities and participate in reflective activities. In this way, they could monitor their ideas, and reconsider the preconceptions they had and consider alternative theories and ideas based on practical work. The work to design, and eventually implement this new program was called the TEEMS Program (Teacher Education Environments in Mathematics and Science). The research reported here focuses only on the science education component of the TEEMS program.

The TEEMS program is designed to prepare secondary science teachers who possess a range of knowledge, abilities and skills including:

- A thorough grasp of the knowledge base undergirding teaching practice based on constructivism, and a repertoire of instructional strategies which result from emersion in an inquiry-based and reflective program.
- An understanding and the ability to use methods of inquiry and research findings in making professional decisions.
- A thorough grasp of a philosophy of teaching that is based on reflective thinking, inquiry and experiential learning.
- Appreciation of the ethical and moral responsibilities of teaching.

Students have been admitted into the program in the spring of each year since1994. Applicants must hold at least a bachelor's degree in science or engineering or the equivalent. Students must also provide letters of recommendation, acceptable scores on the Graduate Record Examination, or the Miller Analogies Test, a minimum GPA (grade point average) of 2.75, and a writing sample outlining why they want to become a science teacher. Candidates meeting these requirements are then interviewed by a team of professors in science education and science, and secondary school teachers. The program, which begins during the summer, is a four-term program leading to a Master's degree in science education and a license to teach

science, grades 7 - 12.

TEEMS' Students.

Since its inception 129 students have been admitted into the TEEMS program in science, as shown in Table 3. Seventy-five of the students have graduated (16 will graduate in August of 2000, while 31 students were admitted to TEEMS and will begin their program in the summer of 2000). Of the 75 who have graduated (an additional 16 will graduate in August 2000), 70 are currently teaching in either middle or high schools in Georgia, as well as in several other states (Ohio, Orgeon, Texas.)

Table 3. TEEMS Students, 1994 - 2000

Year	Applicants	Admitted	Graduated	Employed as Teachers End of Program	Teaching Currently
1994-1995	6	5	5	5	5
1995-1996	64	18	17	16	13
1996-1997	31	12	12	12	11
1997-1998	31	24	22	20	20
1998-1999	36	19	19	17	17
1999-2000	36	16	**	**	**
2000-2001	34	31	*		
Totals	238	129	75	70	66

* Just beginning program ** Still seeking employment

Of the 129 students admitted into the program since 1994, 95 (74%) have been female, and 34 (26%) have been men (Table 4). Ethnically, TEEMS students have been 77% Caucasian, 16% African-American, 5% Asian-Pacific Islander, and 1.5% Hispanic.

Table 4. Summary of Students' Ethnic Backgrounds 1995 - 2000

	Caucasian	African - American	Asian - Pacific Islander	Hispanic	Totals
Female	74	13	7	1	95
Male	25	8	0	1	34
Totals	99	21	7	2	129

Philosophically, the program encourages the construction of teaching strategies and models through an active learning format beginning in the summer term. Students are involved in hands-on/minds-on (Hassard, 1992) strategies designed to help them create active learning environments for the students they will teach. An integration of practice and theory characterizes the work that we have planned for the students. Even in the summer, TEEMS students work with teenagers in an environmental science environment. Pedagogy and practice are seen as twin vistas to help TEEMS students develop the knowledge of teaching. In TEEMS, activity leads to the development of teaching knowledge and theory.

The TEEMS Curriculum.

The TEEMS Program begins each June with a Summer Institute (see Table 5). TEEMS is four term program emphasizing the following pedagogical practices:

- Term 1. Summer Institute focusing on preconceptions of teaching and immersion into a constructivist approach to pedagogy.
- Term 2. A fall semester experience to develop pedagogical content knowledge in the context of middle school students and teachers.
- Term 3. A spring semester experience to develop pedagogical content knowledge in the context of high school students and teachers.
- Term 4. A second summer experience of reflection and portfolio presentation.

In the Summer Institute students in the program are engaged in practical activities that are based on science activities typically used with school age students. The TEEMS students participate in a series of problem solving episodes that focus on the use of science knowledge, inquiry, reflection and hands-on/minds-on activities. This approach is supported other research (Freudenthal, 1978,1991) which was characterized as "the realistic approach" which goes from practice to theory. In the TEEMS program we repeat this process each term so that students encounter new situations through guided practice activities, and school internships.

Table 5. The TEEMS Curriculum

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Term	Curriculum	Focus	Goals	Internship & Teaching Experiences
Term 1: Summer 1998	• TEEMS Summer Institute • Education or Science Coursework	• Reconnaissance of science teaching • Introduction to inquiry-based teaching and learning	Connect preconceptions of teaching and learning to a constructivist approach to pedagogy	• Reflective teaching episodes • Micro-teaching • Team teaching in a summer science camp
Term 2: Fall Semester '98	• Theory and Pedagogy of Science Teaching & Internship in Middle School • Education and/or Science coursework	• Development of pedagogical strategies in the context of middle school classrooms • Reflective analysis of one's ability to plan, carry-out and evaluate teaching & learning	Construct knowledge of teaching through concrete experiences, reflection and discussion	• School-based experiences in a middle school, as well as field trips, and special projects with middle school students and teachers • Working relationship with a mentor teacher
Term 3: Spring Semester '99	• Pedagogy and Internship in a High School • Education and/or Science coursework	• Further Development of pedagogical strategies in the context of a high school • Reflective analysis of one's ability to plan, carry-out and evaluate teaching and learning	Construction of knowledge of teaching through concrete experiences, reflection and discussion	• Apprenticeship in a high school involving special projects • Working relationship with a mentor teacher
Term 4: Summer 1999	• Portfolio Presentation & Assessment • Education and/or Science coursework	• Assessment of one's progress as a TEEMS student • Presentation of Portfolio in a public setting	Know how to use a professional portfolio to reflect on one's growth and development as a teacher	Portfolio Assessment and Presentation

In TEEMS the concept of constructivism is practiced and embodied by the instructors who direct the work of the students throughout their experience in the program. In one sense it our belief that teachers teach in the way they were taught. Thus, each class that we teach whenever we are directly working with the students is organized as a set of inquiry-oriented activities, discussions and reflections. We use a variety of teacher education materials that were developed along a constructivist framework (Hassard, 1992, Hassard 1996, Hassard 1998, Hassard, 1999).

Inquiry-based learning honors the integrity and prior-knowledge (Maslow, 1966) of each of the TEEMS students. We assume that they have a knowledge base about teaching, and in many cases it is quite different than the constructivist model that we are creating. They are immersed in the program from the time they walk into our classroom. The inquiry-based activities are accomplished in small team learning groups. The purpose of the inquiry-based activities is to provide a practical and concrete experience that is used as a referent for dialogue, discussion and writing. Dialogue and discussion are begun in the context of the small groups and eventually come to the whole class in the form of focus group presentations and dialog at the whole class level. Individual reflection is encouraged by asking the students to maintain a journal throughout their program.

These face-to-face sessions help establish a community of practice which is further extended by the use of an extensive web site (Hassard, 1999c). Within the site a number of reflective tools are used to foster community and individual and group reflection throughout the program. One of the most successful Internet tools we have used is the on-line bulletin board. TEEMS students also have access to other communication tools such as TEEMS chat rooms, and a private e-mail list for the group as a whole.

TEEMS students participated in two internships during the year, one in a middle school, and the other in a high school. Figure 1 shows the distribution of the 10 schools that were used during the year. Two urban and three suburban schools were used in each internship, thereby providing the opportunity for the students to work in diverse communities.

Teaching Internships. During the Fall Semester, TEEMS students focus their work in a middle school by designing lessons, working side-by-side with a mentor, and carrying out project-based activities including the development and field testing of a science tool kit, and collaboration with other TEEMS students on an action research project on classroom management. Students spend seven of the15 week semester at school. Focus is placed on the importance of reflecting on the experiences that TEEMS students have, whether in hands-on activities on the university campus, or in experiences in the middle school. Using a reflective journal, e-groups, and the on-line bulletin board in the TEEMS web site, TEEMS students are constantly discussing practice and theory as if they were one.

In the Spring Semester, TEEMS students participate in an eleven-week high school science internship that is more intense than the middle school experience. Emphasis is placed on having the TEEMS intern work with the mentor in a team teaching situation. This is done purposely to encourage collaboration and reflection rather than the usual "practice teaching model" so prevalent in traditional teacher education programs (Korthagen and Kessels, 1999). Instead TEEMS students are involved in project-based activities including the development of a relevant mini-science teaching unit, the creation of a technology-based project, and an investigation of alternative assessment strategies.

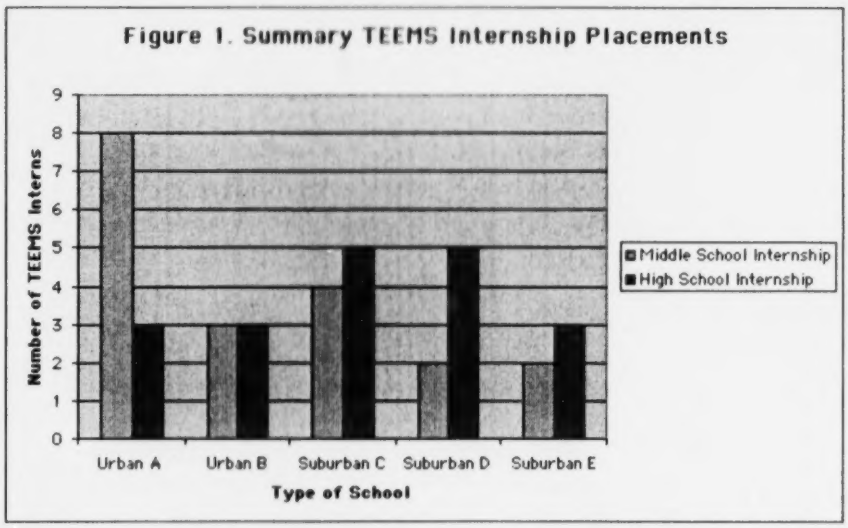

Figure 1 shows how TEEMS students were distributed among the five middle and five high schools that we used during the internships. In each internship we used two urban and three suburban schools to provide a variety of school settings. At least two TEEMS students were placed at each site.

TEEMS students monitored and reflected on their work throughout the year by maintaining a professional portfolio, keeping a journal, and participating in ongoing web-based discussions within the TEEMS web site. The portfolio showcases the TEEMS students' progress and work by the inclusion of documents and artifacts that reflect work over the course of a year. In the second summer term, students present their portfolios at a "science fair" type gathering by not only showing their portfolio but by also creating a three-panel poster board display representing a reflection of their work. New TEEMS students, faculty, mentors, and other interested persons are invited to this event.

The TEEMS Constructivist Learning Environment.

One of the ideas that is conveyed to TEEMS students is the belief that knowledge about teaching is created by the learner, and that through an experiential approach they will have the opportunity to develop and reflect on their own knowledge construction. This is a fundamental principle guiding the instructors in the TEEMS program. We also conveyed to the students that we would engage them as a community of learners in activities that would be grounded in experiential learning. It was important, we told them, that TEEMS learning experiences be characterized as hands-on, reflective, and cooperative.

In the TEEMS curriculum, lecture is a rare event. We organize the experiences (except for the Internship experiences) using cooperative groups. Problems and activities are used to engage the students in the exploration of ideas about science and pedagogy. Using a constructivist model that we have modified from others (Hassard, 1999), the learning experiences for the TEEMS students involve four levels or stages. First, inviting them to consider their preconceived ideas as they relate to the problem at hand. Second, engaging them in an exploration of the topic in small groups followed by discussion, reporting and reflecting by explaining the results of their exploration. Finally, TEEMS students are asked to take action on their experiences. Our role as teacher educators in the TEEMS program is to be a guide or a facilitator (Richardson, 1999, Rogers, 1984) of the learning environment, and to engage the students in hands-on experiences and thoughtful discussions.

Types of Learning Experiences.

The TEEMS program uses three types of learning experiences to foster active learning and construction of science teaching knowledge, and they are:

- Inquiry and Project Based Experiences
- Reflective Experiences
- Internships and Teaching Experiences

Inquiry and project-based experiences. The inquiry and project based experiences are examples of activities designed to engage the TEEMS students in hands-on and experientially-based learning activities. Some of these experiences take place in face-to-face class sessions on the university campus, while others are completed in the context of a middle or a high school. A wide range of experiences have been designed, and most of these are introduced to the students during the Summer Institute (Term 1), and during the first four-weeks of the Fall Semester (Term 2). For example, we experientially teach TEEMS students cooperative learning strategies (Hassard, 1996), and how to implement cooperative learning in various classroom learning situations. Other projects, such as Project Ozone (www.gsu.edu/~mstjrh/projectozone.html) engage students in scientific research in an online learning environment in which they monitor and investigate ground-level ozone in the Atlanta region, and use the Internet to collaborate with others. TEEMS students, working in teams of four, prepare a two-day ozone learning experience designed for upper elementary and middle school students who they work with in a summer science camp environment. This project helps students focus on the pedagogical content knowledge needed to teach about ground-level ozone, by using an inquiry and project-based approach.

What students told us about the inquiry and project-base experiences. Students were asked to rate the experiences that were classified as inquiry and project-based using a seven point Likert scale. Of the inquiry and project based activities included in the questionnaire, students rated (see figure 2) the development and implementation of a website the highest (6.6), followed by fuzzy situations (Hassard, 2000) (6.3), the science tool kit (6.2), project ozone (5.9) and the windows research project (5.3).

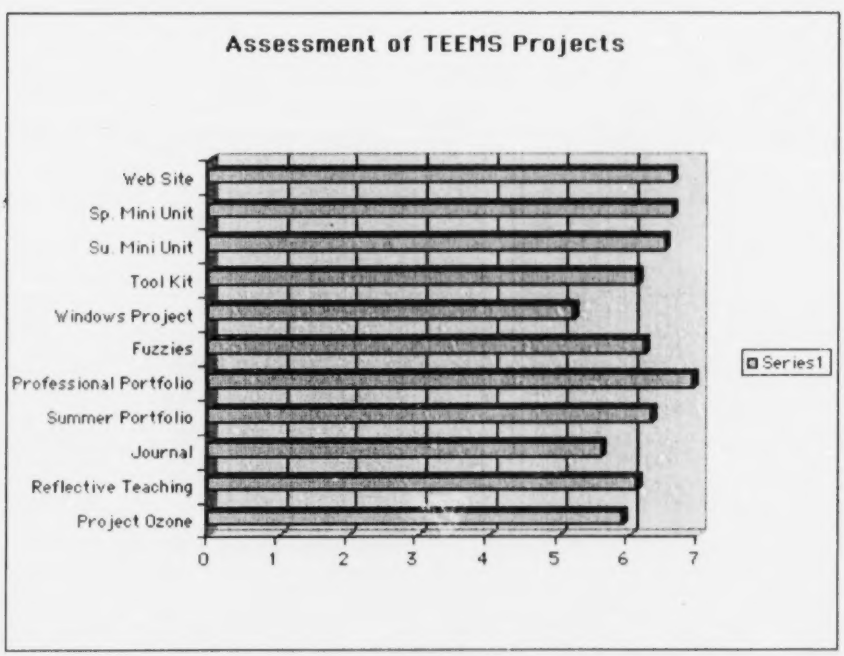

Figure 2: TEEMS' Assessment of Inquiry, Project Based and Reflective Activities.

Reflective experiences.

Reflective experiences were used throughout the TEEMS program, and were designed to encourage student to think about, and ask questions about teaching and learning. The reflective experiences were based on a variety of reflective tools, such as the journal to help students talk and write outloud about problems and issues related to content and pedagogy. Students also used the portfolio concept to synthesize the work that they did throughout the program. Other reflective tools include think pieces (provocative questions about science teaching and learning that students discuss on the TEEMS online bulletin board), reflective teaching episodes (teaching 15 minute lessons to a small group of peers), and the presentation of a portfolio and three-panel poster at a public session.

What students told us about cognitive reflective tools. When we asked the students to rate the cognitive reflective tools used in the TEEMS program, they rated the portfolio the highest (6.9), followed by the website bulletin board (6.3), reflective teaching (6.1) and the journal (5.6).

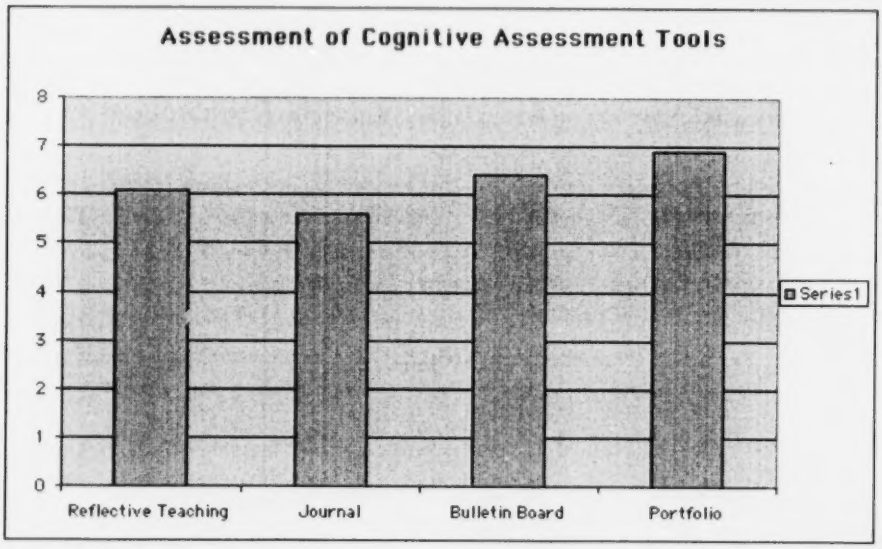

Figure 3. Assessment of Cognitive Reflective tools

Internship and teaching experiences.

Internship and teaching experiences are spread throughout the program. In the Summer Institute, a tradition of having students teach upper elementary and middle school students in a science camp environment has fostered an early exposure to working with school age students. For most of the TEEMS participants, this was their first experience teaching students. As noted earlier, TEEMS students were involved in two teaching internships, the first one focusing on teaching and learning in the context of a middle school, and the second one focusing on the high school.

What students told us about the internship and teaching experiences. Except for the teaching experience in project ozone (rated 5.9), TEEMS students rated each internship, and the reflective teaching episodes in the summer term the same (6.1). They rated TEEMS overall 6.8.

Figure 4. Assessment of Internship and Teaching Experiences

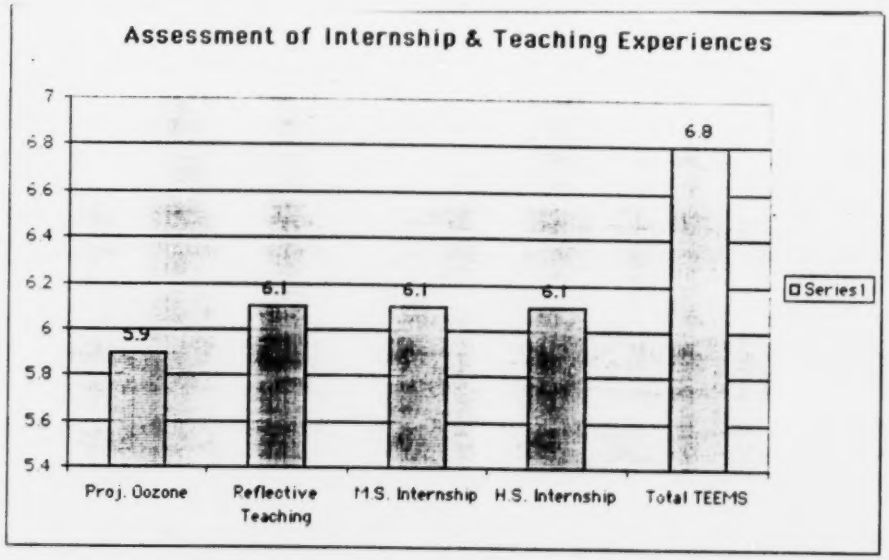

Table 6 summarizes the experiences and shows how we perceive their organization and goals. Details of these experiences can be obtained by visiting the TEEMS website (scied.gsu.edu/Hassard/Teems/index.html/), or the syllabi which are reproduced in the Appendix of this paper.

Table 6. Types of Experiences in the TEEMS Program

Inquiry and Project Based Experiences	Reflective Experiences	Internship & Teaching Experiences
• Cooperative Learning • EEEPs • Project Ozone and the Internet • Mini-unit design and field testing (Summer and Spring terms) • Fuzzy Situation Design • Windows Research Project • Science Tool Kit • Technology Project • Assessment Project	• Reflective Teaching Episodes • Journal • Think Pieces • Online Bulletin Board • Science Teaching Portfolio • Profession Teaching Portfolio • Portfolio Presentation	• Summer Science Teaching Experience • Reflective Teaching Episodes • Peer Mini-unit Teaching • Middle School Internship • High School Experience

The Internet. The Internet was an important communication tool that served to establish a community of learners, and to provide a medium for thoughtful reflection and discussion. We established an interactive web site using WebCT, a course management program available to all professors at Georgia State University. The WebCT environment provides a number of communication tools that we took advantage of to further the sense of community that we tried to establish through our face-to-face meetings, classes, and

internships. Within the TEEMS web site we set up a bulletin board which we used for reflection and discussion, private mail which enabled the cadre to send email to each other individually or as a group, and chat rooms which allowed for real time discussion.

Research Participants

Nineteen students enrolled in the 1998-1999 TEEMS science program participated in the study. Each of the students was enrolled as a graduate student in the Department of Middle Secondary Education and Instructional Technology at Georgia State University. The group was comprised of 13 women and 6 men (see Table 7). The ethnicity of the group consisted of one Asian-American, one Hispanic-American, two African-Americans, and 15 Caucasians. Three of the students had master's degrees in science, while the remaining 16 had bachelor's degrees in science.

Table 7. Summary of Students' Ethnic Backgrounds

	Caucasian	African - American	Asian - Pacific Islander	Hispanic	Totals
Female	10	1	1	1	13
Male	5	1	0	0	6
Totals	15	2	1	1	19

None of the students had a previous degree in education, and very few had taken an education course prior to enrolling in the TEEMS program. Students majored in the following six field of science: biology (12 students), chemistry (3), earth science (1), ecology (1), medical technology (1) and physics (1). Each student had an e-mail account, and nearly all of the students had access to the Internet at home. All students graduated with a master's degree in science education in August 1999. Of the 19 students in the program, 17 obtained full-time teaching positions by August 1999. Two students decided to remain in their present research positions for a year, and then pursue a teaching position for the 2000 - 2001 school year. Half of the students held a Graduate Research Assistantship (GRA) at Georgia State University, and 75% received a H.O.P.E. scholarship to help finance their graduate work.

Participant Activities

All participants were enrolled in the TEEMS science education program which consisted of course work that began in the summer of 1998 and was completed in July 1999. All of the students graduated with a master's degree in science education and a license to teach science in grades 7 &emdash; 12.

They participated in course work for four terms (June 1998 - August 1999) that was divided into three clusters of experiences or courses as follows: science education coursework, professional education course work, and science-content coursework.

TEEMS Science Education Coursework. In their first term, students enrolled in a six-semester summer

institute that was designed as a hands-on, inquiry- and project-based and reflective experience. During this experience students were introduced to the culture of science teaching by working with science education professors and high school teachers. To facilitate the exposure to the culture of science teaching, they planned teaching experiences for middle and high school students in a summer science camp environment. Students also participated in a series of inquiry and project-based activities designed to provide concrete experiences as reference points for growth and change.

Emphasis was placed on students taking on an active role in their own and others' learning. Here are some examples. On the first day of class, each student is given an assignment to plan a lesson (Reflective Teaching Episodes) which they taught to small group of their peers. Using this experience, they reflected on their experience by completing a writing assignment, and began to think about their own ideas about teaching and how this experience can be used to further their understanding of teaching. On another day, small teams of students explored "project-based teaching" by building a paper tower, reflecting in their group on the processes used to solve the problem, and viewing video tapes of high school students doing the same activity. Later in the summer, TEEMS students participated a two-day summer science experience in which they worked with three - four peers to develop a set of constructivist lesson plans which they implemented with a group of middle and high school students.

During the fall semester students took a 6 semester TEEMS experience that integrated pedagogy and internship work in a middle school setting. They explored science teaching in the context of a middle school; worked with students individually and small groups, and on occasion prepared teaching experiences under the guidance of a mentor for middle age students (11 &emdash; 14). Students participated in reflective activities including keeping a personal journal, the development of the professional portfolio, and participation in the TEEMS bulletin board in the TEEMS web site. Students were placed in clusters of five or six in one of five middle schools that were used for this experience. At each site, students met as a group at the start of the day to check in with one another, and to review plans for the day. These meetings also were attended by instructors in the TEEMS program.

In the spring semester students enrolled in a 6 semester TEEMS experience in the context of a high school. During this experience, TEEMS interns worked with a science mentor teacher to explore science teaching at the high school level. The internship was designed to provide learning experiences for students in which they planned and carried out various teaching experiences. Students designed and field tested teaching materials, designed a technology project (such the use of an interactive Internet bulletin board, or a collaborative science project on the Internet), and explored alternative forms of assessment. Reflective activities include a personal journal, the further development of a professional portfolio, and participation in the TEEMS bulletin board.

All of these experiences were coordinated and taught by the same team of instructors who started with the students in the summer term. Furthermore, two high school teachers participated as instructors in the Summer Institute, and were mentors in the middle and the high school internships.

The schools used in the internships represented a variety of school settings in the Atlanta area. Inner city and suburban schools were used in the TEEMS program. The instructors who coordinated the program selected the schools, and worked with the mentor teachers to establish an environment conducive to constructivist teaching. Although not always successful, we found that each school experience was worthy in its own way. Although these are not professional development schools, four of the schools that we worked with have been part of the TEEMS program for three years. In one case, a Ph.D. student (co-author of this paper) in science education and a teacher at one of the schools coordinated the efforts to establish a reflective environment (Dias, 1998a). Using a focus group model, Dias worked with seven interns at his

school to explore what constitutes effective science teaching (Dias, 1998b).

Professional Education Coursework. TEEMS students were required to take a total of four courses in the fields of education research (many students take a course in action research), learning and cognition, human growth and development, and a course in exceptional children and youth. Many of the students took a course in action research, and in combination with one of the TEEMS inquiry and project-based activities (See the "Windows Research Project" in the Fall Semester syllabus), designed an action research project which they carried out during the fall semester internship.

Science Coursework. Students took 15 semester hours of coursework in science. Each student entered the program with a degree in science or engineering. Students' prior experiences in science were assessed to determine the nature of their graduate science experiences. Their graduate experiences were designed to give them "broad field" science certification. Thus, many students took courses in areas that were absent from their prior science course work. We also encouraged the students to take courses in science that were inquiry and activity-oriented.

Data Sources

A variety of data sources were used during this study which focused on students ideas about constructivism, and teaching experiences that they considered working in the context of classrooms during their internship experiences. Four data sources were utilized: 1). interview questions which helped gain insight over time as to what TEEMS students thought about science teaching concepts including constructivism and experiences they found working in the schools, 2) focus group reports which brought together students in small teams to brainstorm and discuss their internship experiences, 3). artifacts which included journal entries and web-based bulletin board discussions of their experiences and 4) video tapes of various experiences throughout the TEEMS program.

Data Analysis

Each of the research questions was answered from several perspectives because of the variety of data sources available. Analysis of the questions was done by triangulating the data to expand the richness of the answers to each of the questions, and reduce bias. &#0;To analyze the depth of understanding of the students' conceptions of constructivism, a category system (Table 8) described by Perkins, Crismond, Simmons and Unger (1995) and used in a recent study by Hoffman and Krajcik (1999) was used. Questionnaires were administered prior to, during, and after their internships, and their written statements were analyzed using the following categories and definitions as shown in Table 8.

Table 8. Coding Categories for Depth of Content Understanding (After Hoffman and Krajcik, 1999).

Level and Code	Description
Recalling Information (RI)	Recalling, stating, and repeating facts and concepts, processes methods and theories. This depth of understanding involves simply stating or repeating a fact or idea from some other source. There is little or no interpretation.
Offering Explanations (OE)	Explaining, telling or describing facts and concepts, processes, methods and theories. This depth involves telling or describing with examples. Statements are complete thoughts with a high degree of coherence and meaning.
Articulating Relationships (AR)	Articulating, expressing, relating facts and concepts, processes, methods and theories. This depth involves expressing ideas with rich explanations, relating or linking ideas, often with examples.
Extending Explanations (EE)	Extending, expanding, revising facts and concepts, processes, methods and theories. This depth of understanding involves expanding ideas to new situations or circumstances, revising information, or providing new examples.

Top

Results

The results are organized around the three sets of questions, which guided the study and the data analysis. Assertions are made for each section, followed by an analysis of the data.

Question 1: What depth of understanding do TEEMS students posses and communicate about the concept of constructivism? How does their understanding compare and change at different points of their program?

Assertion: TEEMS students constructed an understanding of constructivism that was meaningful and practical. Their written explanations of constructivism included primarily offering explanations and articulating relationships. Post internship explanations were at a deeper level of understanding than the period prior to their work with middle and high school students.

To analyze students' depth of understanding of constructivism each students' responses to questions asked in a written questionnaires prior to and after the internship period were coded using the categories described in Table 8. As shown in Table 9, the depth of understanding of constructivism was spread across three categories. When asked what is constructivism, one student responded "It is the method of trying to undo all the negative, wrong, or misconceptions about science that students have developed." A number of other TEEMS students connected misconceptions research to constructivism. For example, one student said, "In the constructivist model, the level of understanding of your students is extremely important; it enables students to correct misconceptions and learn new material in creative ways." A number of students thought of constructivism as a model, as seen in this statement. "It is a step wise model of teaching starting

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with inviting students to learn by sparking their interest."

Table 9. Summary of TEEMS Students' Conception of Constructivism at the Pre &emdash; and Post-Internship Points.

	Pre-Internship	Post-Internship
Recall Information	3	0
Offer Explanations	6	10
Articulate Relationships	5	6
Extend Explanations	0	0

Post-internship understanding of constructivism changed in the direction of more depth, as shown in Figure 5. None of the student interview responses were at the recall of information level; indeed all were at the level of either offering explanations or articulating relationships. In general their responses were richer and showed a deeper understanding of the importance of relevance ((Korthagen and Kessels, 1999). One student commented that constructivism "relates science to the real world through hands-on activities, discussion or dialog with students, and lectures that relate current events and science." One observation that was evident was that TEEMS interns referred to students in their explanations more often after their internships. For example, one TEEMS student commented that constructivism "employs students taking an active role in the learning process; the constructivist method emphasizes the student taking charge of his/her learning while the teacher guides.

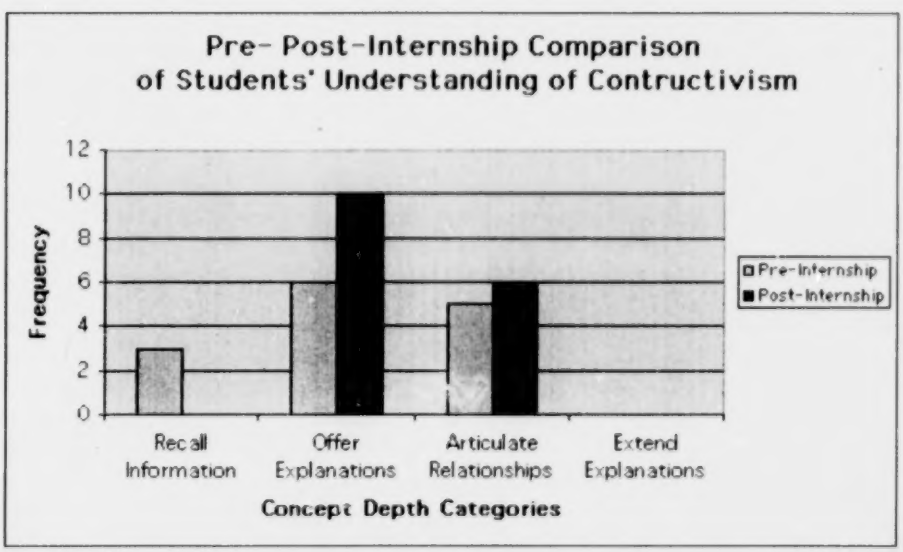

Figure 5. Pre-Post

Internship Comparison of Students' Understanding of Constructivism.

Question 2: What was students' conception of the practical relevance of constructivism? To what extent did they think they could implement constructivist practices in their internships? And to what degree did they think they would be able to implement constructivism in their first year of teaching?

Assertion: TEEMS students predicted that they would be able to implement constructivist practices in their internships and in their first year of teaching, and for the most part were able to implement constructivism during their internship experiences. However, more than a third of theTEEMS interns indicated that they would not be able to carry constructivist practices into their first year of teaching.

A summary of the analysis of a series of questions related to the students' predictions about implementing constructivism and whether they were able to use constructivist approaches in their internships is shown in Figure 6. Students were asked the following three questions:

- 1). To what extent do you anticipate being able to implement a constructivist approach to teaching the middle school this semester?

  2). To what extent were you able to implement a constructivist approach to science teaching in your internship experiences this year?

  3). To what extend do you think you will be able to implement a constructivist approach to science teaching in your first year of teaching.

Seventy-eight percent of the students felt they would be able to implement constructivism in their internships. Student commented that their predictions about implementing constructivism would depend upon the mentor teacher.

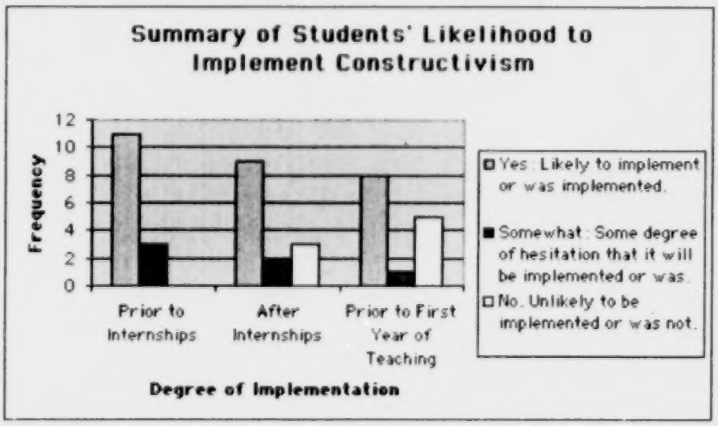

Figure 6. Summary of Students' Likelihood to Implement Constructivism.

One student stated that "a big part depends upon the teacher; most lessons can be incorporated into a constructivist approach." However most students were quite sure they could implement and made very affirmative statements such as:

- "I hope to use the constructivist approach as often as I can because I believe that

middle school children need that kind of motivation and structure to approach a task or subject. I think that the constructivist model makes learning fun and I am all for that---I think the students will be too!"

When TEEMS students were asked if they were able to implement a constructivist approach, 64% said they did. This is slightly less that the percentage that predicted they could. Furthermore three of the students reported that they did not implement a constructivist approach, and two indicated they were only able to implement constructivist lessons some of the time. One student, who implemented constructivism, also commented that the approach allowed too much freedom. The student put it this way: "I was able to implement the constructivist method in the middle school, but it allowed too much freedom; implementing at the high school level was constrained by the content. Overall it would have been better implemented in a more disciplined middle school setting."

Students began to understand some of the benefits of a constructivist or more active-learning approach. Here's what one of the TEEMS students said:

- "When I started observing the classrooms I would teach in, I noticed these students were very bright and smart, but very quiet. I began to wonder if they would benefit more from more active participation. Whenever I've had the chance to teach them, I have tried to encourage their participation, always trying to probe their prior knowledge and clarifying misconceptions, so when they hear any new concept, they can make a connection in their cognitive concept map. It is very satisfying to observe them understanding, asking challenging questions. Confusion is many a times integral part of learning new concepts in science."

Students during their internships had successful experiences using a constructivist approach. They found some success implementing active learning lessons and using reflective approaches such as journals, electronic bulletin boards, and portfolios. One student commented when interviewed about what types of "cool" pedagogy they were using this way:

- "The cool pedagogy I have been using is of course "TEEMist." One example is an activity in which the kids created and acted out skits explaining the evolution of the modern atomic model of matter. I grouped the kids according to the main scientists and their models of matter. It was quite entertaining and much better than me lecturing about these scientists. I also completed my alternative assessment and technology project. The kids kept reflective journals/learning logs which were very informative for me and hopefully educational for the class. For the technology project the students built an interactive carbon atom on the www.pbs.com web site. The site is called of course 'Atom Builder.' After they built their atoms they completed an Internet Scavenger Hunt."

Students were also asked to consider the degree to which they might be able to implement constructivism in their first year of teaching, which for these TEEMS' students would be the 1999-2000 school year. Figure 6 shows that 8 of the students (57%) felt they would implement constructivism. However, 5 of the students (36%) thought they would not be able to implement constructivist activities. One student predicted difficulties in this way: "I see it as a hard thing to do because I will be trying to keep my head above water. Maybe I will use it in a couple of plans, but the whole year will be rough." However even students who felt they could not implement in their first year perceived their development as a "constructivist teacher" as a long-term process. The student put the problem this way:

- "The basics of the constructivist model seem logical but require a lot of planning and preparation. Although I feel more comfortable with the constructivist model now, I am afraid my attention will be divided amongst many issues in my first year that it will be difficult to implement the model 100%. Over time, as I settle into my teaching style, I will keep what I feel works for me and modify that which doesn't. I'm sure my overall approach to teaching will be based on the constructivist mindframe but who knows what new models will have caught my eye by then!"

The view of the students with regard to the possibility of implementing a constructivist approach in their first year of teaching is very positive.

Question 3: What pedagogical strategies did TEEMS students describe that "worked" in the classroom during their internships? What pedagogies did they think they should "let go?" How did these pedagogies relate to their understanding of constructivism?

Assertion: TEEMS students identified four broad categories of activities that worked in their internships. Activities that worked were student-centered, and involved group work. Students also found that using alternative assessments and the Internet were successful.

A summary of the analysis of the question "What worked for you during your internships?" is shown in Figure 7. At the end of their internship experiences, students answered this question as part of the Post-TEEMS Survey. Analysis of the student comments resulted in the emergence of four categories, which were then used to code the student comments. The categories of "activities" included 1) cooperative learning or group activities, 2) pedagogical variety, 3) alternative assessments and 4) Internet experiences.

In both the middle school internship and the high school internship TEEMS students emerged with cooperative learning or group work as a fundamental strategy that worked for them. Cooperative learning appeared to work in diverse settings as well, including urban middle and high schools, as well as suburban schools. Students also learned that group work led to social problems within the class. Students quickly found that smaller sized groups were not only a

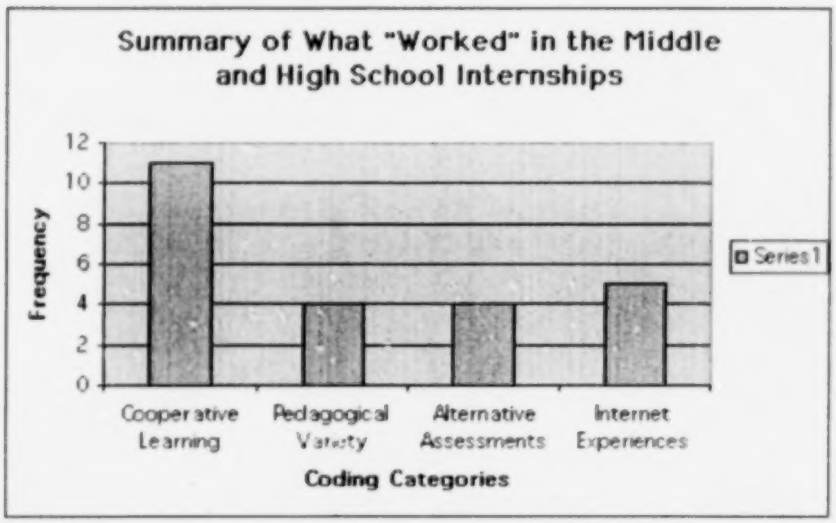

Figure 7. Summary of What "worked" in the middle and high school internships.

solution to the many of the social problems that emerged in group work, but, smaller sized groups led to more active learning.

Cooperative learning (or some form of group work) was identified in the post-TEEMS survey and in on-line bulletin board discussions most frequently as a pedagogy that worked (see Figure 4). Although this is not surprising since the professors that directed the TEEMS science education experiences used cooperative learning strategies nearly all of the time, students began to experience cooperative learning as a professional teacher. One student made this observation about cooperative learning:

- "I tried out a jigsaw method with my students. It was very much like the activity we did this past summer when we split into four groups and each group learned a different model of teaching, and then we split up and taught the model to the other groups. I used this for the periodic trends (ionization energy, atomic size, electron affinity and electronegativity). I think it worked really well. The students got to learn by helping each other out in their own groups. Everyone participated because each person had to understand the material well enough to be able to teach it to another group. I circulated among the groups while they were preparing in order to clear up any confusion or misconceptions. The students enjoyed it and it was definitely better than a lecture!"

Pedagogical variety was term invented for coding. After examining the post TEEMS survey, on-line discussion, and focus group sessions, students sited a number of different pedagogical strategies that worked. These tended to be specific "tools" that began to use during the middle school internship and because of success there, carried them forward into the high school internship. Some examples included using T-charts (Hassard, 1998) to uncover students prior-knowledge, using EEEPs (Hassard, 1999a) which are inquiry-based cooperative learning demonstrations, and others. One student's comment on the survey, which was coded as pedagogical variety made this comment: "What worked for me---T-charts and toolkit activities. I invented my own strategy for doing labs in a constructivist manner. Student loved my web page activities and other Internet activities."

Throughout the TEEMS program, students experienced and reflected on the value of using alternative assessments methods. Indeed the TEEMS students experienced alternative assessment first-hand. They kept a reflective journal throughout their program. They developed two different portfolios---one in the summer term and the other over the course of their internships. We also conducted seminars on alternative assessment, and their resource materials (texts) included much material on this. Thus it was no surprise that in the area of assessment, TEEMS students were reflective in their internships about assessment. Students tried out a variety of assessment strategies in their internships including student learning logs, portfolios, having students complete projects, performance-based tests, group presentations, and the use of rubrics to assess student performance.

The Internet was also a pedagogical strategy with which students found success. In some cases TEEMS students were more experienced using the Internet than their mentors, and this created a role-reversal. In the case of Internet applications and use in the classroom, the TEEMS students led the way in many of the internship classes. These TEEMS students introduced the Internet into their mentor's classrooms. Although the access to the Internet in most of the schools was in the media center where 10-20 computers were located; students managed to incorporate the Internet into their lessons.

When TEEMS students were asked what things did not work, they listed items including:

- Worksheets

- Overhead notes for students to copy
- Students watching teachers work "problems" at the chalkboard"
- Trying to teach the book

Although most of the TEEMS students agreed that the above strategies tended not to work, they also discovered that a strategy that worked one day, did not necessarily work the next day. Here is how one student viewed this issue:

- "Classroom management issues changed as often as the collective mood of the class changed (and that was very often). What worked one-day to calm the students didn't always work again. The kids loved group work but they performed better in a structured environment (the more instructions the better). I found that when given time to "discover" on their own, they did just that... they discovered 101 ways to be off task. Also, these kids love to talk to each other, to me, to anyone that will listen so I found that large groups are much harder for them to manage. Assigning tasks in groups worked better than not since there was no question who was responsible for what. And, presenting in front of the class was a big hit with them. Getting to know the kids also worked well with me. The hardest students to deal with, though, were those with ADHD. No amount of getting to know them or calling out their names in class seemed to work, consequently, these students were my worst behavior problems in class. Putting a new spin on an old activity can really draw the students into a lesson. I did a demonstration involving chemical reactions that the kids had seen before but they didn't know that each reaction produced a different gas. I had them use a candle flame to identify the new gas (either CO2 or O2) and each has a unique effect on the flame. The kids really enjoyed it and because they had previous experience with the reactions, it made teaching the lesson even easier. I also found it to be true that asking higher order questions of the students held their attention better than asking simple questions. These students needed more practice in problem solving skills since most of their work is based on fill-in-the-blank worksheets but they seemed to rise to the challenge of pondering some slightly off-beat questions I posed to them."

Discussion

The purpose of this study was to explore how students in the TEEMS program experienced a constructivist teacher education learning environment and how the approach impacted their ideas about teaching and learning. The study used a methodology that incorporated the opinions and ideas of 19 prospective secondary science teachers enrolled in four-term teacher education program. Data was collected using questionnaires, on-line bulletin board discussions, interviews, journal records, and video tapes of some of the TEEMS class sessions.

The results of this qualitative study lead to a number of conclusions about the experience of students in a constructivist teacher education program. The conclusions drawn must be tempered with the realization that these are prospective teachers who have not begun their formal careers as secondary science teachers. However data from multiple sources provides some insight into prospective science teachers ideas about constructivism, the degree to which they were able to implement constructivist practices in their internships, and their predictions about how constructivism will play a role in their first year of teaching.

Firstly, we can assert that these prospective teachers described constructivism as a construct beyond mere recall (stating and repeating) and were able to go beyond this category of understanding to offer explanations and articulate relationships. One of the problems in teacher education programs is that many of the concepts "taught" in education courses appear to fall by the wayside once prospective teachers participate in internship or student teaching experiences (Sprinthall, Reiman, & Thies-Sprinthall, 1996).

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TEEMS interns in this study developed more depth in their understanding of constructivism after their middle and high school internships. Indeed they appeared to embody the concept even more strongly as they reflected on their internship experiences. We can speculate that the continuous dialog and reflection on constructivism as a referent for their teaching contributed to this knowledge growth. Further investigation is needed here to see what happens to these prospective science teachers as they enter teaching next year. Dias (1999) has completed a study that followed four of these TEEMS students into their first year of teaching. Using a series of in-depth and semi-structured interviews, reflective writing and teaching documents, Dias is investigating the "learning-to-teach process among these four teachers, and hopes to report on the relationship between their implicit theories of teaching, and the pedagogical thrust of the TEEMS program.

Secondly these interns not only predicted they would be able to utilize a constructivist approach in their internships, but reported that they were able to do so after their middle and high school internships. As pointed out in the description of the TEEMS program, students interned in groups of three to eight persons in urban and suburban schools in the Atlanta region. TEEMS interns in each of these settings reported they were able to implement constructivist ideas. It is important to point out that the interns reported experiences with constructivism in terms of what did and did not work in middle and high school classrooms. Students realized that " What worked one day didn't always work again." This is a good example of the general principle of "situated knowledge" in which students in TEEMS through their interaction with problem situations and learners began to use these concrete situations to develop "teacher knowledge."

We can also conclude that these prospective secondary science teachers described as "what worked" in the internship experiences as constructivist pedagogies. Cooperative learning, alternative assessment strategies, and reflective internet activities emerged as the strategies that TEEMS interns identified as most useful. When students first entered the TEEMS program, most of the students did not have positive experiences with group learning, especially in their university studies. In TEEMS they were immersed in a constructivist learning environment in which most activities were organized using cooperative learning. Cooperative learning, alternative assessment and the Internet became a "way of life" for the TEEMS interns, whether on campus throughout the year, or in their internship experiences.

TEEMS is a paradigm rooted in the epistemology of constructivism. Inquiry-based learning activities and reflective practices on the part of TEEMS students in the context of school-based internships provided the environment that Korthagen and Kessels call "realistic teacher education." The constructivist teacher education environment of TEEMS appears to contribute to a deep understanding of constructivism and the teaching practices needed to implement such practices in internship-type experiences.

This research project was descriptive and contributed to our understanding of students understanding and application of constructivist practices while in the program. What happens to these students once they enter the profession? As stated earlier, Dias (1999) has completed the data collection of a study looking into the pedagogical decisions that TEEMS students in this program make during their first year of teaching. Four participants in this study were part of a one-year investigation of the challenges that these TEEMS students face. Most of them indicated that they would be apply to carry the construct of constructivism with them into their first year; however five TEEMS students felt they would be impeded, and might have to temper their use of constructivist practices. It will be important to follow these students into their first year of teaching.

This study also needs to be repeated with a new group of TEEMS interns. Other questions that should be examined include the following:

- 1. What is the connection between the inquiry-oriented practices presented in TEEMS and the kind of teaching exhibited by the mentor teachers that participate in the TEEMS program?

  2. What are the initial preconceptions that TEEMS students have about teaching and learning, and how do these compare to constructivism? To what extent does a realistic teacher education program impact prospective teachers' views of learning?

  3. What kinds of environments are conducive to the implementation of constructivist teaching?

Another area that needs to be investigated is the role of teacher education professors in a program such as TEEMS (Howey and Zimpher, 1999). What knowledge and beliefs among professors foster the creation of constructivist environments? What pedagogical knowledge do professors need to possess?

Teacher education programs that are rooted in the epistemology of constructivism, and create practical and experiential learning environments show promise for the development of prospective teachers who use their experiences to develop insights and knowledge about teaching.

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Welcome to The TEEMS Science Website

Post TEEMS Survey (Hidden)

High School Internship Sp '99

Bulletin Board

Private Mail

Chat rooms

High School Assessment Forms

Calendar of Course Events

White Board

Student Web Sites

Course Syllabus:Su/Fall 98

Agenda Fall 1998

Fuzzy Situations 1998

G.I.F.T.S.

Fuzzy Situations Project

Science Tool Kit Project

Middle School Science Internship

Research Tools Online

Windows into Science Classrooms Project

Using the INTERNET as a Science Teaching Tool

Project Ozone

Course Materials for the Summer Institute

Agenda

Class Activities	Homework and Other Stuff
June 27, Wednesday **Introduction to the Course: A Reconnaissance** • Your Initial Conceptions of science teaching • Two "models" of teaching---what do you think? • On the nature of science---your ideas, and the ideas of kids • On the nature of science teaching---wisdom of practice • Effective teaching or "How to teach science real good!" • Themes and issues in science teaching: brainstorming and identification of student suggested topics. The Syllabus---a walk through The Science Teaching Portfolio Introduction to reflective teaching.....preparing your first lesson!	Purchase a notebook for your learning log....begin by reflecting on today's class. Prepare a reflective lesson (if you are assigned to teach on Wednesday, June 22). Active Reading: Chapter 1, Minds On Science (MoS), Skim the Wongs' Book and find sections relevant to today. Active Writing:Select anyone of the Problems and Extensions on page 35 of MoS, and use this writing to reflect on your ideas of science and/or science teaching.
June 22, Monday Active Learning Strategies • EEEPs • Multiple Abilities Strategy • Multiple Intelligences Designing a Science Mini-Unit-Intro • Brainstorming Reflective Teaching Rounds 1, 2, and 3. Teach lessons, small and large group reflective teaching discussions.	*Goals due* Active Reading: Increasing Your Students' Science Achievement, pp 1- 51. MoS: 55-70, 210-224; 246-272 Active Writing:Read the Science Teachers Talk Section on page 241 in which science teachers talk about discovery/inquiry teaching. What is your view on this subject given the stage of your professional development? What are some questions you might have for these teachers about the implementation of an inquiry approach to teaching?

http://webct2.gsu.edu/SCRIPT/TEEMSjrh/scripts/student/serve_page?882560079+summerinstitute/agenda655.html+BODY

June 24, Wednesday Designing a Science Mini-Unit • Identifying focus questions • Developing a concept map Learning Cycles • Conceptual change model • Constructivist model • Person-centered learning model • Generative learning model Constructivism in the Bag • Big ideas in science • Designing lesson sequences Reflective Teaching, Rounds 4, 5, and 6. Teach lessons, small and large group reflective teaching discussions. Generate theory of reflective teaching. How will reflective teaching theory and practice be of help to me as a teacher?	*Mini-Unit topic chosen* Active Reading: Science Achievement Book, pp. 101-126; MoS: 54-70, 217-224. Active Writing: Write your critique of reflective teaching sessions. You have been asked to teach a group of 6th graders a lesson sequence on your favorite science topic. Using the lesson sequence model on page 107 of Science Achievement, write a set of science lesson sequences for your favorite topic. Be prepared to share your results with a small group. **Prepare your reflective critique; its due on June 29.**

June 29, Monday
 	
Constructivist Lesson Sequences
 	
Designing a Science Mini-Unit
 	
• Identifying intended learning outcomes
• Categorizing outcomes
 	
Project-Based Science Teaching
 	
• Rationale for project-based teaching
• Action Project Examples
  ○ Paper tower
  ○ Rubric
 	
<u>Project Metro Ozone</u>
 	
Cooperative Learning Seminar....
Practical/hands-on strategies for using cooperative learning to enhance science teaching.
 	
Refine Themes/Issues
	Reflective Teaching Critique due
	
	Lesson Sequence due
	
	Concept Map due
	
	Active Reading: MoS: pp. 298-324
	
	Science Achievement, pp. 55-74. MoS: pp. 272-283, 292-294
	
	Active Writing: Read the Science Teachers Talk section on page 343 in MoS. Which teacher did you relate to more and why so?
	
	What do you think about project based science teaching? What do you see as some of the problems of this approach for you as a science teacher?
	
	Work on cooperative learning lesson which will be presented in a team teaching format on July 1.
	
	Project Ozone Monitoring!!!!!

July 1,Wednesday <u>Project Metro Ozone</u> • ALICE and TERC • Internet workshop Designing a Science Mini-Unit • Writing a rationale Presentation and video taping of the cooperative learning lessons. Discussion of the value of cooperative learning in the science classroom; limitations and strengths.	*Cooperative Learning Lesson Plans due* *Ozone Readings due* *Learning Outcomes due* **Work on Mini-Unit**

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July 6, Monday Preparing for Project Ozone on Kennesaw Mountain • designing the day's activities The Motion of a Pendulum • constructivist lab • inquiry Designing a Science Mini-Unit • Generating a list of activities • Revising Concept Map Classroom Management. How would you manage a middle and high school science classroom? What principles would guide your plan? How would you "set up" your classroom? Issues and topics related to CM. Refine Themes/Issues	*Rationale due* Active Writing: Write a short paragraph on the use of labs in the science classroom. How has your view of labs changed after today's pendulum lab? Active Writing: Project Ozone at Kennesaw Mountain Preliminary Lesson Plans **Prepare Kennesaw Mountain Lesson Plan Proposal**
July 8, Wednesday Meet with your group to complete final details for Project Ozone lessons for Kennesaw Mountain. Technology and science teaching • Use in science classrooms • search and discussion • The Internet: designing a computer based activity Classroom Management continued Refine Themes?Issues	*Kennesaw Mountain Lesson Plan Proposal due* **Design an internet scavenger hunt for students about your mini-unit.** **Search the Internet for Mini-Unit Activities** **Work on your Portfolio**
July 13, Monday Models of Teaching: Direct Vs Indirect. Viewing videos of teachers using various models of teaching. Introduction to direct/indirect teaching skills. Project Ozone- work in groups Designing a Science Mini-Unit • Developing specific lesson plans • teacher/student interactions • Utilizing the Internet-Scavenger Hunt Portfolio Presentation to peers Themes/Issues group time	*Turn in lesson plans for Project Ozone at the end of the day* *Mini-Unit Activities due* *Bring in your Portfolio so far* Work on themes and issues presentation. Active Writing: develop specific lesson plans for your unit. **Plan and prepare lunch for your Kennesaw Mountain Group**
July 15, Wednesday **Kennesaw Mountain.** Project Ozone teaching episodes with middle school students; Picnic; Project Wild and OBIS science activities.	Active Writing: Reflect on your experiences at Kennesaw mountain. How have your ideas of teaching science changed? What surprised you about teaching outside? What went well? What could have been improved?

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July 20, Monday
 	
Seminar on significant themes and issues in science education. Each group will have 25 minutes to present their seminar. An outline or brief handout should be included with your team's presentation.
 	
Pre-Assessment Strategies
 	
Active Reading Strategies
 	
Performance Assessment Strategies
 	
• What have heard?
• A model of assessment
• Types of observations
  ○ Student Talk
  ○ Student Writing
  ○ The Student Log
  ○ Open-ended questions
  ○ Portfolios
  ○ Performance Tasks
  ○ Rubrics
  ○ Designing paper/pencil & hands on assessment tasks
 	
Designing a Science Mini-Unit
 	
• Developing an assessment plan
	Issue Paper due
	
	Specific Lesson plans for Mini-Unit due
	
	Internet Scavenger Hunt due
	
	Readings: Science Achievement: pp. 121-163; MoS: 330-342.
	
	Writing: What, in your opinion, is alternative assessment? How is it different than traditional assessment? What do you think about the use of alternative assessment?

July 22, Wednesday Mystery Curriculum Science Education Reform Movements • SS & C • Science for All- Project 2061 • National Science Education Standards Gender Equity and Science Teaching Mini-Unit Final brainstorming	*Assessment Plan for Mini-Unit due* Active Reading: pp. 395-409, p. 424-425, MoS. Active Writing: Choose one of the Think Pieces on page 421, and prepare a short response **Finish your Mini-Unit**
July 27, Monday Mini-Unit Teaching.....Each TEEMS' intern will present a science micro-lesson, have it video-taped and then view the tape for reflection and change.Display and discussion of science mini-units that were developed during the course....rooms to be announced. Portfolio Presentations • Looking back over the summer program • Looking ahead	***Portfolios due*** ***Camera Ready Copy of Mini-Unit due today*** Active Writing: What did you learn about teaching today? What were some of the strengths and weaknesses of the lessons you participated in during class? What was your overall impression?
July 29, Wednesday Mini-conferences with your instructors...Room 681 COE Building.	**Course Evaluations**

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Course Evaluation Form

TEEMS Summer Institute 1998

Name:_____Date:_____

Learning Log	Poor	Fair	Good	Outstanding
Organization	1	2	3	4
Consistent documentation	1	2	3	4
Creativity	1	2	3	4
Demonstrates Growth	1	2	3	4

Comments:

Literacy Assessment	Poor	Fair	Good	Outstanding
Reading List	1	2	3	4
Writings	1	2	3	4

Comments:

Projects	Poor	Fair	Good	Outstanding
Reflective Teaching Critique	1	2	3	4
Cooperative Learning Lesson	1	2	3	4
Science Mini-Unit	2	4	6	8
Science Education Issues Presentation	1	2	3	4
Kennesaw Mountain-Project Ozone	1	2	3	4

Comments:

Portfolio	Poor	Fair	Good	Outstanding
Organization	1	2	3	4
Reflections	1	2	3	4
Creativity	1	2	3	4
Completeness	1	2	3	4

Comments:

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Class Participation	Poor	Fair	Good	Outstanding
Participation/Attendance	1	2	3	4

Synthesis	Poor	Fair	Good	Outstanding
Overall Assessment of Your Work	1	2	3	4

Comments:

TOTAL POINTS (out of 72):_____

Final Grade:_____

Instructor(s):_____Date:_____

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Goals and Objectives

Unit Theme: Creating Contexts for Learning

Program Theme: Teacher as a Facilitator and Reflective Professional

Focus of the Summer Institute

Helping students understand ideas about the world of science through personal experience is one of the fundamental goalsof science teaching in today's schools. Helping you learn how to do this is the central purpose of the TEEMS ScienceSummer Institute, as well as the science internships that will take place during the Fall and Spring Semesters. TheSummer Institute will engage you in a variety of experiences in science education that are experiential, inquiry oriented,and reflective.

The TEEMS program will encourage a reflective and constructivist philosophy of teaching in which you will examineyour prior knowledge of teaching, and then explore science teaching experientially, as well as by asking thoughtfulquestions of reflection such as what am I doing and why? To integrate the process of reflection and construction, you willbe asked to evaluate your own work by using assessment tools such as the portfolio and learning log.

Objectives:

- 1. Know about a rationale for a hands-on, minds-on, inquiry-oriented approach to science teaching. Consider questions and issues related to the nature and philosophy of science.
- 2. Know how students learn science in terms of recent theories of learning and science education research.
- 2. Know how to use several models of teaching including the direct/interactive teaching model; inquiry models of teaching, constructivist models of teaching, and cooperative learning models.
- 3. Know about the goals and history of science education and their relationship to science teaching practice.
- 4. Know various strategies such as asking questions, encouraging writing, and aiding student reading that foster thinking in the science classroom.
- 5. Know how to use computer-mediated telecommunications to foster student collaboration and research in science.
- 6. Know how to assess student learning using traditional and nontraditional methods, e.g performance assessments, writing, group problem solving, portfolios, and alternative tests.
- 7. Know how to engage students in activities that focus on science, technology and society and social responsibility of science in the classroom

Institute Requirements:

There are several aspects of the course which will be required. These are as follows:

- The first requirement is that you make a list of the goals that you will work on during the quarter.
- The second is that you participate in a number of Learning Projects during class and assigned for after class.
- A third requirement is that you keep a reflective log of your experiences this quarter. Your log should include a reflective discussion of each class and comments related to your work during the quarter.
- The fourth requirement is a Science Teaching Portfolio described herein.

Grading and Assessment:

Assessment of your performance in this course will be determined by a combination of methods. Your participation and products from the assignments will be evaluated by the instructors. The overall assessment of your progress as a science teacher will also include an evaluation of your portfolio and your reflective log.

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TEEMS Science Summer Institute Portfolio

Your work in the TEEMS Science Summer Institute will be evaluated based on the construction and submission of your portfolio. Your portfolio will consist of samples of your work selected from the list of learning projects described below. You are encouraged to think carefully about the list, and choose the portfolio elements (learning projects) that reflects your interests and goals. The first FIVE elements are required; you should select FOUR additional elements from those listed here.

The selection of portfolio elements must be done so that your portfolio includes evidence of abilities for:

- using a knowledge base undergirding science teaching practice based on constructivism, a repertoire of instructional strategies, and skills to apply these to the science education of students in the schools, K-12.
- using methods of inquiry and research findings to make professional science education decisions.
- transcending your own personal experiences in order to make instructional decisons.
- understanding methods of assessment and measurement that explore nontraditional or alternative realms of assessment.
- understanding the ethical and moral responsibilities of educating youth in a system of compulsory education.

Procedure for Developing Your Portfolio

- Save everything you do in the science methods class.
- Determine your goals for the course---after session #1 (June 17), prepare a list of goals and make two copies to be turned in by June 22.
- Determine the elements you wish to include in your portfolio. Look at the list ahead; remember the first five are required and you should select four additonal from the others listed here.
- Purchase a three-ring binder and bring it to class by June 29.
- After you decide which element to include in your portfolio, create sections using tabs or some other form to separate each element.
- For each element, complete a "Self-reflection on Your Portfolio Element Form" and include it as the first page of the section for that element.
- Complete the work for each element, and turn your portfolio in on July 27.

Portfolio Elements and Explanations

Elements	Explanation
Science Teaching Mini-Unit (Required)	Develop a science teaching mini unit based on the processes described in class. Mini-unit should consist of five lessons, and include a title page, the unit as defined in class, references, and any ancillary materials (handouts, lab sheets, assignment sheets, etc.). The mini-unit should be typed. Two copies will be required, one for your portfolio and one for copying.
Kennesaw Mountain Lesson Plan Report (Required)	Working with a team of peers, develop a lesson plan that you will field test with a group of middle & high school students at Kennesaw Mountain. The lesson plan report should also include student feedback forms, as well as your written lesson critique. You might also want to document this with photogaphs.
Internet Progress Report (Required)	A brief report summarizing your progress and your accomplishments using the Internet.
Science Education Bibliography (Required)	A LIST of the readings that you did in the TEEMS Science Summer Institute and the way you have read the book, article, chapter, paper or Internet source. For example, you might list a book and state "Chapters 5 and 8 were read thoroughly." You might list another book and sate "skimmed the book and found it irrelevant to my current goals." You might list another item such as an article and say, "I got so much out of this that I read it twice and made careful notes. In other words, what is wanted is an honest account of what you have read and the depth to which you have read the material.

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Learning Log (Required)	You should turn in as part of the Portfolio a learning log which consists of reflective writing documenting your work in the Summer Institute. Log entries should be 1) brief; limit each day's entry to no more than two facing pages in your log; 2) include left brain (verbal/logical) and right brain (intuitive,holsitic,artistic) entries to reflect your thinking; 3) be made for each day of the Institute; 4) be kept in a separate book.
Think Piece	Complete a Think Piece on some topic on science teaching. You will find lots of Think Piece suggestions in the Gazette pages of Minds on Science. Your completed think piece can be a narrative or can be a poster type report.
Favorite Assessment Strategy	Describe an assessment strategy and showcase one you have developed or used during this quarter. Discuss how this assessment strategy evaluates student learning.
Favorite World Wide Web Sites	Using the computer resources on campus, identify five or your most favorite science/science education sites on the Internet. Try and download the homepage of each site, and be sure to include URL address as well. Discuss how you would use these sites in science teaching.
Favorite Science Teaching Model	Using illustrations and diagrams, discuss your favorite science teaching model, eg. direct/interactive, constructivist, inquiry, and cooperative learning.
Your Philosophy of Science Teaching & How It Has Changed	Write a short report that describes your philosopy of science teaching and how it has changed or not changed as a result of your participation in the TEEMS Science Summer Institute.
Concept Development	Become an "expert" on a chapter in Minds On Science by reading and studying the chapter in detail, and perhaps going beyond the text to seek out other references. Make a concept map for this chapter and any embellishment that you think is appropriate
Science Teaching Issue Report	Document the Science Teaching Issue that you researched as a member of a team. Your documentation should include a discussion of the issue, references and a brief description of the presentation that your team made to the class.

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Course Materials for the Fall Middle School Internship

Syllabus

EDSC 7550/EDCI 8660; Theory and Pedagogy of Science Teaching and Middle School Internship

Fall Semester 1998

Instructors:

Jack Hassard, Ph.D. Professor of Science Education 678 College of Education Building Department of Middle Secondary Education and Instructional Technology Phone: 404-651-2518 E-mail: jhassard@gsu.edu http://www.gsu.edu/~mstjrh/	**Nydia Hanna, Ph.D.** Assistant Professor of Science Education 604 College of Education Building Department of Middle Secondary Education and Instructional Technology Phone: 404-651-0172 E-mail: nhanna@gsu.edu

Unit Theme: Creating Effective Contexts for Learning

Program Theme: Teacher as a Reflective Professional

Course Description: Helping students understand ideas about the world of science through personal experience is one of the fundamental goals of science teaching in todayÕs schools. Integrating science pedagogy with an internship in the middle school helps bridge the connection between theory and practice. These two courses, in conjunction with your experiences in the TEEMS Science Summer Institute of 1998 will continue to provide a variety of experiences in science education that are characterized as experiential, inquiry oriented and reflective. The continuum of experiences provided by these integrated courses will encourage a reflective and constuctivst philosophy of teaching in which you will examine your prior knowledge of teaching, and then explore science teaching experientially. The Internship experiences will afford an opportunity to further construct knowledge about science teaching through interaction with your mentor teacher, middle school students, and peers while still retaining the guidance of professors from GSU. To evaluate your progress as a constructivst science educator, you will be asked to participate in a number of action projects, keep a reflective journal, and begin the development of your Professional Science Education Portfolio (PSEP).

Course Objectives

- Know to implement various teaching strategies such as asking questions, encouraging writing, and aiding student reading that fosters thinking in the science classroom.
- Know how to assess student learning using traditional and nontraditional strategies including performance assessments, writing, group problem solving, portfolios, and alternative tests.
- Know how to develop activities that are based on social responsibility and the interaction of science, technology and society.
- Grasp the essence of how middle school students learn science in terms of inquiry, reflection and constructivism.
- Design lessons that show variety in your repertoire of teaching strategies including inquiry-based, project-based, constructivst-based, and direct-instruction-based models of teaching.
- Plan, carry out and evaluate science activities and lessons in a middle school.
- Assess your performance and participation as a science teacher/intern in a middle school.
- Reflect on, and discuss significant issues related course topics including the philosophy of the middle school, middle school science curriculum, strategies that work in middle schools, motivation of students, and inquiry in the middle school science classroom.
- Explore the science curriculum, teaching materials and computer technologies available for middle school science learning.
- Develop a rationale for science teaching at the middle school encompassing the particular issues of multicultural education, exceptional students, and gender equity.
- Explore the middle school environment by participating in an action-project related to key themes of the middle school internship.

Inquiry Questions

- How do middle school students learn (science)?
- What is the philosophy of the middle school?
- How can the concept of "constructivsm" be applied to the teaching of science at the middle school level?
- What are some ways of planning science lessons and what is best for you?
- What are some examples of exemplary science programs for middle school science?
- What is the character of the science curriculum in your middle school?
- How would you evaluate the science curriculum at your middle school in light of the National Science Education Standards?
- What are some of the best ways to teach specific science concepts in the middle school?
- How can science teaching impact positively at-risk and low achieving students?
- What are some of the crucial issues in science teaching at the middle school level today?

Course Requirements:

- **Goals/Action Plan**: The first requirement is that you determine and prepare a list of the goals for your learning as a TEEMS intern and submit an action plan outlining how you will accomplish each goal. You list of goals should be organized into six categories (those that will define the scope of your Professional Science Education Portfolio): planning, instruction, evaluation (of student learning), management (leadership in the classroom), knowledge of science and pedagogy, and professionalism. These should be submitted by September 2, 1998.
- **Action Projects**: The second requirement is that you participate in several Action Projects, which are outlined below. Each project has a specific criterion for accomplishment. You should also consider inclusion of the products of the projects in your portfolio.
    - **STS Fuzzy Situation**: Write a "Fuzzy situation" story based on a social responsibility issue or in the domain of the interaction of science, technology and society. The story must ask students to integrate content knowledge, logic and creativity. Include criteria that each student must include in their answer or description. Be sure to ask for a prediction or an opinion. Fuzzy situations should be posted within the TEEMS Web-assisted course by September 11.
    - **Science Toolkit**. Prepare a hands-on/minds/on "Science on the GO" Toolkit for a class of 25 students. Utilize everyday or easily accessible materials and supplies in a portable container. Base your "kit" on a middle school science topic and field-test it while in the middle school. Access Internet resources to expand your creative ideas. Include all data collection sheets, questionnaires, references, information for students and teachers and a complete listing of materials as well as a detailed description of the lesson (Purpose, Objectives, Procedures, Assessment). Camera-ready copy due on November 18.
    - **"Window" Into Science Classrooms Project**. During your internship in the middle school, you will have the opportunity to view a science classroom through different windows or perspectives. Choose a "window" from the text for this Action Project and design a project in which your team can answer key focus questions. Your team will prepare an action plan to be carried out while you are in the schools. We will begin the project prior to your internship. After the internship each project team will present the results during a seminar on campus on November 18.
    - **Develop a Science Teaching Web site**. During the quarter you will develop a professional science teaching web site which should consist of several pages, including a home page. The Science Teaching Web site should be put up in your GSU Panther account, and be made available to others in the class.
- **Reflective Log and Discussion on the Net**. A third requirement is that you keep a reflective log of your experiences this quarter, and participate in reflective discussion on the Internet within the TEEMS Web course. Web-discussions will occur on the "class bulletin board," as well as in TEEMS chat room. Your log should include a reflective discussion of each class and the days you are interning in the middle school. You might use writing prompts such as the following to help you reflect on your experiences:
    - When I think about my own experiences at the middle school level, I wonder whyÉ
    - In planning lessons and activities in science, I nowÉ
    - In reflecting on my own ability to plan and teach lessons to middle school students, I now feel thatÉ.
    - The first day at schoolÉ.I wonder whyÉ.
    - After working with the kids, I learned thatÉ
    - Teaching science in the classroom wasÉ
    - When you start using the "class bulletin board" you will have the opportunity to participate in a number of forums that are posted on the BB.
- **Internship.** Teaching Internship in a Middle School. You will intern in a middle school for a period of six weeks during the semester. Your internship will involve you in tutoring, teaching small groups of students, planning and carrying out science lessons, and participating directly in the activities of your mentor teachers. You should document your experiences. All teaching episodes must have a lesson plan. These should be kept in a notebook and be available to your mentor and college instructor. Use your log and your portfolio to keep your observations and artifacts for the quarter.
- **Portfolio**: You will begin the development of Professional Science Education Portfolio (PSEP) this semester. Your portfolio will be used to document your work. Refer to the portfolio guidelines for specific details about the six categories that are required.

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Fall Semester 1998 AGENDA

Fall Semester 1998

Tentative Agenda

Tentative Agenda	Assignments
August 24É.296 Kell ● Getting Started: TEEMS on the Web ● Middle School; philosophy, curriculum, students and teachers	● Log In to the TEEMS Web site on WebctÉgo to www.gsu.edu/~mstjrh/teems.html and click on the Fall Semester Course; from there follow the instructions to Log in. You will choose your own ID and passwordÉrecommend you use your panther information ● Explore the TEEMS Website and respond to the first topic in the TEEMS Bulletin Board on middle school philosophy. ● Read about MS Philosophy in Chapter 4 of Minds on Science
August 26É254 CoE ● A Look at the TEEMS Webct Course ● Middle School Curriculum; Earth, Life, PhysicalÉ.from your ideas of key concepts to textbook companyÕs views to National Science Education Standards ● Developing Your TEEMS Website; special session to be announced	● Read Chapters 2 and 4 in Minds on Science ● Look at Science for All Americans book; connect to the content of middle school science, e.g. Earth, Life, and Physical. ● TEEMS Bulletin Board ● Check your TEEMS E-mail
August 31 ● Social Responsibility and the Science, Technology and Society Concept ● Nature of SR & STS	● Look over Chapter 6, of Minds on Science and come away with a grasp of SA and STS, and potential teaching examples for middle school kids ● A Chat with Dr. Roger Cross, La Trobe University, AustraliaÉ. TEEMS Bulletin Board ● Science for All Americans
September 2 ● STS Themes and how to teach them ● Strategies for teach SR and STS: clarifying values, STS dilemma sheet or video, action dramas, voting, case studies, Internet projects	● Write fuzzy situation based on a SR or STS issue; include criteria for each student to incorporate in their answer and be sure to ask students to make predictions and state opinions. ● Goals and Action Plans Due Today ● TEEMS Bulletin Board
September 7 ● No Class	

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September 9 • STS Curriculum Materials • STS Internet Sources • Science ToolKits Introduction	• SFAA Concept Map Due • TEEMS Bulletin Board • Read Chapter 1 & assigned Chapter in Windows into Science Classrooms • Fuzzy Situation Due
September 14 • Windows into Science Classrooms Project • Windows Activity; looking at teacher roles, gender, cognitive levelsÉthe 4 "rÕs", and what students do in science class; connection to middle school learning	• Read Windows Chapters related to your teamÕs project • Use Website to Chat About your project • Your TEEMS Website should be on the Internet Today
September 16 • Windows Project Development; work with your team to outline the approach to your windows project; brief reports in class • Internship Session I: Focus on goals and expectations	• Team report: write an outline of how you will carry out your Windows Project; one member should prepare a 200 word abstract, and post it on the TEEMS Bulletin BoardÉabstract should include the title, names of co-developers and abstractÉ.
September 21 Internship Session II • Contract for Internship • Responsibilities • Case studies and role play • Safety in science teaching Windows Outline	• Windows Project Outline Due • TEEMS Bulletin Board
September 23 • Internship contracts/Mentor Packs • Problems/Solving in the Internship Environment	• TEEMS Bulletin Board
September 28 &emdash; November 6 • **Middle School Internship** • **Daily: 7:30 A.M. &emdash; 12:00 Noon** • **Seminar on campus on October 19th at 10:00 A.M.**	• **Keep a Daily Log of Internship Events** • **Detailed Lesson Plans for each lesson taught** • **Have Log and Lesson Plans available** • **TEEMS Bulletin Board; check in and participate on a "regular basis" throughout the Internship period**

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November 9É254 CoE • Seminar on the Internship: What did we learn? What do we need to work on? How will we do it differently? • Looking Toward the HS Internship for Spring Semester	• TEEMS Bulletin Board • Be prepared to share some of the key leanings as a result of your Middle School Internship
November 11É254 CoE Website Presentations and Exploration What is the focus of your website? How will you use your website? What changes will you make?	• Make sure your website is ready to be sharedÉ. • TEEMS Bulletin Board
November 16 & 18 Windows ProjectÉ.Work with your project team to get ready for the seminar on November 23rd.	
November 23É254 CoE • Windows Project Presentations (this will be organized like a science conferenceÉeach team will have 30 minutes to present the results of their projects	• Presentations should be accompanied by an abstract of 200 words, and a "project" paper with copies for each TEEMS student • Portfolios Due
December 2 Last Session of the Semester • Individual Conferences with your instructors • Lunch together	

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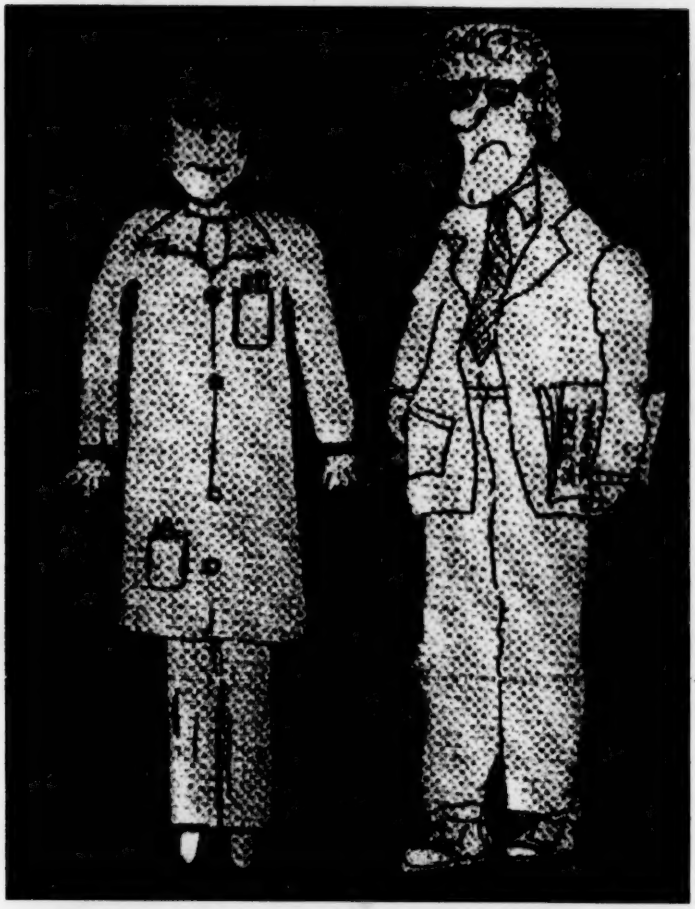

WINDOWS INTO SCIENCE CLASSROOMS

AN ACTION PROJECT

The Windows Project.... What's it all about?

In the past several years, science education research discovered that listening to and watching practicing teachers in their classrooms was a powerful way of becoming informed about the nature of science teaching. In fact, the work by these researchers is more than listening and watching; it involves participation. Thus participant-observer research has become a favorite approach by a large number of science education researchers---worldwide.

This project---the Windows Project---relies on an in-depth study done in Australia by American and Australian science educators. The population studied by the researchers was two high school science teachers....Peter and Sandra....shown above.

We are going to use the study as a foundation for helping you plan and carryout a science teaching project to shed light on "problems associated with higher-level cognitive learning."

Stage One: Prior Beliefs and Ideas

- Discuss with one another the circumstances in which students learn best in a science class. Make a list of your assertions.
- Consider the question: Why do you teach the way you do? Discuss this question and then make a list of "principles" or "beliefs" underlying science teaching.

State Two: Looking into Classrooms

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You are going to observe a video of a science teacher and focus on one of the following issues, or questions. Gather data as needed during the observation period.

1. What metaphors guided the teacher's behavior in the classroom? Here are three possible metaphors:

- Entertainer----teaching is like acting
- Captain of the ship---being up front and in charge.
- Teacher as a resource---available, assisting students

2. Consider two views of teaching:

- The cultural transmission model
- The constructivst model or view

In the cultural view, students acquire information through a process of absorption. We might rename the cultural transmission model, the absorption model. In the constructivst view students learn through interaction, and construct or invent their own knowledge and understanding. We might rename this the experiential model. What model is in operation in the classroom you observe? What is your data to support your hypothesis?

3. Consider the assertion: There are no gender differences in this teacher's classroom in interactions or work patterns." What evidence can you gather to support or refute this assertion?

4. What is the cognitive demand of the lesson you observed? Consider two possibilities.

- Cognitive demand #1: Students participate in the science lesson, complete and activity or exercise to illustrate what is asserted to be the correct answer by the textbook or the teacher.
- Cognitive demand #2: Students are involved in problem-solving exercises during which they are asked to consider specific questions by testing a particular hypothesis.

What cognitive level seemed to prevail? How could the cognitive demand of the lesson be changed?

5. What do students do in science class? Consider the following categories of behavior. Estimate the % of time devoted to them.

- Individual work:
  - Active: reading, writing, using equipment; talking with teacher
  - Passive: copying work; watching and listening to on task groups, but not participating in a discussion or activity
- Group work
  - Interacting with other students by discussing, getting and using equipment or discussing work with the teacher
- Whole class work: watching films, slide, experiment or demonstrations, listening to teacher directions or explanation, and participating in class discussions or question and answer sessions.
- Off-Task: students clearly off task, either alone (gazing, doodling, watching off task students), or socially (messing about with other students, dealing with social agendas)

Stage 3: Exploring one aspect of Peter and Sandra's Teaching

	"I think of teaching pretthy much as performing…I do love interacting with students. It was my way of stopping the class and pulling about eight kids out of the class, to do an activity which involved these students and also the entire class, that had me, I guess, as the sort of the captain of the ship out front and directing…I get a lot of the adrenaline surge out of teaching. I am the kind of teacher who does love to direct and dominate." **Who said this?**

Your group will select one of the topics and prepare an experiential report for the class about your "topic." To guide you in your work, you might consider the following questions as you examine a particular chapter in Windows:

- What is the point of the chapter?
- Make a list of the main assertions in the chapter.
- Create a concept map of the chapter.
- How can the chapter assertions be represented graphically or pictorially?

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Your team's goal is to "inform-teach" the rest of the class about your topic so that as a class we can "construct" a holistic view of Peter and Sandra's teaching, and therefore help us understand in a more profound way problems associated with trying to teach toward higher cognitive learning. Each group will present through a different colored glass or window into our two teachers' classrooms. The chart below outlines the possible topics for investigation.

Topic	**Questions**	**Chapters in *Windows***
1. Teacher Mind Frames	What metaphors guide the teacher's behaviors?	Chapter 3
2. Real Students Take Chemistry & Physics: Gender Issues	What are some of the issues surrounding gender for the science teacher? How might the issue of gender influence/impact teaching and learning?	Chapter 4
3. Teaching for the Four Rs: Rigor, Relevance, Representative structure and Rational powers.	How is it possible that intelligent, hard-working teachers permit their classes to be characterized by rote learning and recall of memorized information? What are some examples of teaching episodes or examples that illustrate anyone of the "Four Rs?"	Chapter 5
4. What Students Do in Science Class	What are the patterns of participation in a science class? How does student motivation affect participation patterns in science class?	Chapter 6
5. Students' Perceptions of Their Classroom Environment	How do students perceive the learning environment? How do their perceptions compare with researcher observations? Teachers observations? How can student perceptions be measured?	Chapter 7
6. Barriers to Higher-level Cognitive Learning in Science	How does the teacher make a difference in either over-coming barriers or creating barriers?	Chapter 8

	What actions lead to higher-level cognitive learning in the science class?	

Stage 4. Application

Your group will do a combination of the following.

- Present the results of your team's investigation into one aspect of Peter and Sandra's teaching.
- Design a group project to be carried out in a school during the semester. Although not a formal research investigation, the project should focus on one or more inquiry questions related to the topic of interest, e.g. teacher mind frames, gender, student perceptions of the learning environment. Your team should create an action plan that you will use to gather information relevant to the topic. This might involve classroom observations, interviews, discussions, and collection of artifacts. Near the end of the semester, your team will present the results of your project. The presentation should be accompanied with a 200-word abstract and a short paper summarizing the project.

http://webct2.gsu.edu/TEEMSjrh/assignments/windows.html

Professional Science Education Portfolio

Prepare a portfolio that demonstrates your growth as an intern in the TEEMS program. To do this, you will determine and prepare a list of goals for your learning as a TEEMS' intern and document your growth and learning. Your list of goals should include statements about the following areas of your TEEMS' experience: planning, instruction, evaluation (of student learning), management (leadership), knowledge of science, and professionalism.

Portfolio Development

Your portfolio will be a document that showcases and evaluates your work during the TEEMS Program. We will use the guidelines outlined here to create portfolios.

Principles:

- Portfolios should reflect student ownership of learning.
- Portfolios should present evidence of growth and learning as learners and interns
- Portfolios should represent one of a variety of assessment tools.
- Portfolios should contain process and product as evidence.

Purpose:

- To improve your ability as a science teacher
- To integrate instruction and assessment
- To facilitate your learning as a TEEMS graduate student
- To provide evidence of your learning and growth

Contents:

- Contents should match your goals of the TEEMS program.
- There should be a variety of forms of evidence.
- A variety of people can contribute to your portfolio (e.g. parents, students, peers, mentors, university professors, yourself).
- You should have pieces of evidence to show your progress in areas such as planning, instruction, evaluation, management (leadership), the content of science & professionalism.

Some examples are as follows:

- **Planning**: process used; lesson plans & unit plans, notes
- **Instruction**: student evaluations, peer/mentor evaluations; your reflections, videos & critiques of your teaching
- **Evaluation**: assessment plan or model; tests, performance assessments, description of student projects, results of student projects
- **Management (Leadership)**: leadership plan; video; map of your room, reflective notes
- **Science Knowledge**: audio/video tapes of you teaching science, science projects, learning log samples; tests and test results; essays; discussions
- **Professionalism**: readings & reactions; learning log samples; notes of conferences/meetings with faculty/parents/students; attendance at professional meetings

Procedures

- Save everything you do during the TEEMS Program.
- Determine your goals---after session #1, prepare your goals, and make copies for yourself, your mentor and your instructors.
- Determine what documentation you will use as evidence of your growth as a science teacher
- Begin to develop your portfolio. Your portfolio can take a variety of forms (e.g. binder, folder, file folder
- As you decide what to include in your portfolio:
    - a. Make a selection and date it.

      b. Identify the piece and give the context to help the reader gain an understanding of it.

      c. Include a caption outlining your rationale for placing the piece in your portfolio, what it says about your as an intern, the personal meaning it has for you, and what your next steps might be.

      d. Organize the pieces in your portfolio so they are easy to locate and present a developing picture of your growth as a teacher.

- You will make a presentation of your portfolio to the TEEMS Interns at the end of the Spring Semester to include all your growth, work, and experiences during the year with TEEMS. This will be a day in which you will not only show your portfolio, but you will also develop a "science fair" three-panel poster of your work as a TEEMS graduate student.

Portfolio Evaluation Criteria

Name

Form(5)

- Organization
- Neatness

Content: Holistic (12)

- Relevant
- Meaningful
- Meets goals
- Demonstrates growth as an intern

Content: Analytic (18)

- Planning
- Instruction
- Evaluation
- Management (Leadership)
- Science Knowledge
- Professionalism

Reflection (8)

- Clear
- Demonstrates growth
- Reflects goals
- Meaningful

Total

1. On a separate sheet of paper, please provide support for the grade that you have assigned yourself.

2. On a separate sheet of paper, please write your reflection on the portfolio process.

http://webct2.gsu.edu/SCRIPT/TEEMSjrh/scripts/student/serve_page?882560079+Syllabus/portfolio.html+BODY

References and Websites

Textbooks

American Association for the Advancement of Science (1989). *Science For All Americans* . Washington, D.C.: AAAS. (Available in the GSU and Georgia Bookstores)

Hassard, J. 1998. *Increasing Your Students' Science Achievement.* Bellvue, WA: Bureau of Education and Research (Available from Copy USA)

Hassard, J. 1992. *Minds on science: Middle and secondary school methods.* New York: Harper Collins, Publishers. (Available in the GSU and Georgia Bookstores)

Hassard, J. 1998. *Using the INTERNEt as an Effective Science Teaching Tool* . Bellevue, WA: Bureau of Education and Research (Free From Your Instructor)

Wong, Harry 1998. *The First Days of Teaching* . Harry Wong and Associates.

Science Education References by Perspective

General: Your 'basic' list of Science Education Stuff

Curriculum

Global, Gender and Multicultural Perspecitves

Learning

Models of Teaching

Philosophy

Science and Technology

Journals & Associations

The Science Teacher---journal published by NSTA focusing on secondary science teaching.

Science Scope---journal published by NSTA focusing on middle school science teaching.

Science and Children---journal published by NSTA focusing on elementary science teaching.

Electronic Journal of Science Education---journal published online on a variety of science ed topics.

Journal of Research in Science Teaching----research journal published by NARST.

Science education----another good research journal published by AETS.

Journal of Science Education and Technology---research integrating technology and science teaching.

Websites

Eisenhower Clearninghouse for Science and Mathematics: A benchmark site for science and mathematics teachers. The site is useful for research on science education, as well as for lesson plans and links to other science education sites.

Global Schoolhouse: The leader in the use of the Internet to enhance school learning. The Global Schoolhouse has been involved in the activity of the Internet since 1984.

Science Education Associations Home Page: A site that brings together all science education professional associations, their activities, and publications.

Contract for Internship in the Middle Schools

TEEMS Science Program-----Fall Semester1998

T EEMS Interns Should:

A. Preliminary Actions

_____1. Read the teacherÕs handbook of school rules and system policies

_____2. Examine resources for teaching science including curriculum guides, texts, supplementary materials, media and technology materials including computers and Internet connectivity, software and science equipment.

_____3. Visit and interact with personnel in:

- _____the media center/media specialist

  _____the school counselor

  _____the principal/assistant principals

  _____the lunch room staf4. Visit other science classrooms and other subject area facilities.

B. Actions in the Science Classroom

_____1. Keep a written "record" of all lesson plans in an organized notebook or folder.

_____2. Teach and/or team teach with your mentor as many science classes as possible.

_____3. Participate in tutorial or small group teaching.

_____4. Discuss routines of teaching:

  _____beginning of class

  _____rules of student behavior

  _____collecting and grading homework

  _____ending class

_____5. Identify techniques to reinforce acceptable student behavior

_____6. Compile a "log" of hints for teaching supplied by the mentor teacher.

_____7. Grade papers and keep the roll.

_____8. Develop assessment measures with assistance of your mentor.

_____9. Discuss middle school issues.

_____10. Develop/create assessment strateiges, both traditional and non-traditional.

_____11. Prepare and carry out laboratory/hands-on activities.

_____12. Relate technology to as many teaching plans as possible.

-

C. Professional Science Teacher Activities

_____1. Observe teachers in other classes and departments.

_____2. Examine the curriculum for the middle school science program.

http://webct2.gsu.edu/SCRIPT/TEEMSjrh/scripts/student/serve_page?903056786+assignments/contractmiddle.html+BODY

_____3. Find out about teacher and student support services provided by the school.

_____4. Investigate teacher activities in extra-curricular school committees or clubs.

_____5. Participate in team meetings and/or teacher workdays.

_____6. Observe a parent-teacher conference.

_____7. Be on time.

_____8. Dress professionally

D. Additional Goals

The Intern has successfully completed or demonstrated each of item initialed above.

Mentor Teacher_____ Date _____

TEEMS Intern _____Date_____

http://webct2.gsu.edu/SCRIPT/TEEMSjrh/scripts/student/serve_page?903056786+assignments/contractmiddle.html+BODY

Course Materials for the Spring High School Internship

TEEMS Science High School Internship

Spring Semester, 1999

Syllabus

Agenda

Mini-Unit

Technology/Internet Project

Web Chat

Web Discussions

Questions? Contact Jack Hassard

TEEMS Internship in High School Science Teaching

Spring Semester, 1999

Objectives of the Internship

- to apply what you are learning about science teaching and learning in the context secondary schools..to make the transition from middle school teaching to high school teaching
- to further construct knowledge about science teaching through interaction with students, mentor teachers, peers, and university professors.
- to develop a rationale for science teaching at the high school level encompassing the use of technology to assist learning in science.
- to design science teaching lessons and a mini-unit integrating direct, inquiry, constructivist and cooperative learning models of teaching.
- to plan, carry out and evaluate science activities/lessons/units in the context of high school science classrooms.
- to use reflective strategies and assessment tools to evaluate your progress as a science educator.
- to know how to assess student learning using traditional and nontraditional methods, e.g. performance assessments, writing, group problem solving, portfolios, and alternative tests.
- to know how to engage students in activities that focus on science, technology and society.
- to understand how high school students learn science in terms of inquiry, reflection and constructivism.
- to explore the science curriculum, teaching materials and computer technologies available for the high school science program.

Course Requirements

There are several aspects of the course which will be required. These are as follows:

1. The first requirement is that you make a list of the goals, action plan and evaluation that you will work on during the semester. Type the list of goals, and e-mail them to your TEEMS Professor supervising your High School Practicum by January 13. We will respond by e-mail to you. You might use a chart like the following to develop your ideas:

Goals	Action Plan	Evaluation Plan
Goal 1:		
Goal 2		
Goal 3		

2. The second requirement is that you participate in a number of Action Projects in the context of your high school practicum. Each project has a specific criterion for accomplishment. You should consider inclusion of these projects within your portfolio of your TEEMS experience.

3. A third requirement is that you keep a reflective log of your experiences this quarter. Your log should include a reflective discussion of each class and the days you are interning and the anecdotal comments related to your work in the class this quarter. PLEASE MAKE SURE THE LOG IS EASILY AVAILABLE FOR US TO READ WHEN WE VISIT YOU AT THE SCHOOL SITE.

Action Projects

Science Mini-Unit. During your internship you should develop a science mini-unit that consists of between 6 and 10 lessons. The mini-unit should be based on the curriculum that your mentor teacher is responsible for teaching. Develop the mini-unit using the same procedures that we used during the summer term, e.g. use the mini-unit you developed this summer as a model. The mini-unit MUST be used with a group of students in one of the classes you are teaching.

Lesson Planning Project. Organize all lesson plans that you develop into a three-ring binder. The binder should be available to your TEEMS professors each time that you are visited.

Alternative Assessment Project: During this semester in the high school, you will see various assessment strategies being used by your mentor teacher(s). Evaluate these assessments and design your own alternative assessments for the same material. The assessments you develop may be based on an assessment plan or theory that you feel addresses science learning in the high school.

Technology Project: The integration of technology and science education is an important theme for the TEEMS program. During your Practicum in the High School, you will develop a project based on the use of technology in learning and teaching science. This project may utilize technology as a teaching tool for the teacher or as a learning tool for the students. Your goals for the quarter should include field testing the technology project in the high school. Click here for more information and ideas about technology projects.

Portfolio: Continue the development of your portfolio that you started in the Fall semester. Keep in mind that a portfolio documents and showcases your work, and the growth of your work over time. You will present your "portfolio-in-progress" to a peer for comments and suggestions in March. Then in April you will present your portfolio and develop a poster report the synthesizes your learning in the TEEMS program. The presentations and poster reports will be showcased and presented in the College of Education.

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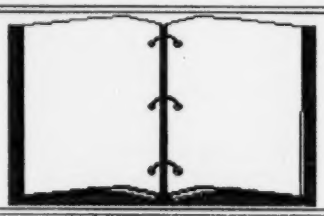
TEEMS AGENDA

High School Internship

Spring Semester 1999

Pre-Internship Seminars **January 11 - 14, 1999** 	Discussion of Plans for the Semester The High School Curriculum Science Safety Issues Preparing for the Projects: Technology, Assessment, Mini-Unit and Lesson Plans
High School Internship Period **January 19 - April 2, 1999** Seminar: Mid-way through the Internship, we will hold a seminar on campus. TBA	Chattahoochee High School--Jan. 19 (Jack Hassard) Decatur High School--Jan. 19 (Ed Lucy) Grady High School--Jan. 19 (Nydia Hanna) Harrison High School---Jan. 25 (Jack Hassard) Mays High School--Jan. 19 (Sheila Rivera)
April 5 - 9 TEEMS BREAK	
April 12 TEEMS Seminar--10 AM - 12 PM, room 296 Kell	Reflecting on the High School Internship
Week of April 19: Portfolio/Poster Session	

Science Mini-Unit

A TEEMS Project

Your mini-unit should be related to the content of the course that you are teaching. You might select a chapter of the textbook that you are using for the basis of the mini-unit.

- Your mini-unit should have the following characteristics:
- Represent about 6 - 10 days or lessons of instruction.
- Be organized in the same manner as the mini-unit you constructed during the summer term.
- Include the following components:
    - Title
    - Objectives/Learning Outcomes (organized into cognitions, cognitive skills, affects)
    - Concept Map
    - Rationale for the mini-unit: why is the this important?
    - Detailed Lesson plans
    - Assessment Strategies

You should visit this web site to gain further competence in developing a mini-unit:

http://www.gsu.edu/~mstnrhx/457/stsexp.htm

Developing An Internet Project

An Example of a Technology Project

The integration of technology and science education is an important theme for the TEEMS program. During your Practicum in the High School, you will develop a project based on the use of technology in learning and teaching science. This project may utilize technology as a teaching tool for the teacher or as a learning tool for the students. One of your goals for the semester should include field testing the technology project in the high school.

Getting Started

My comments on this page will focus on technology projects that utilize the Internet. Although your technology project does not have to utilize the Internet, I strongly recommend that your technology project, what ever it is, have some link to the Internet. You might develop a Powerpoint presentation that includes resources from the Internet, or design a lab activity that utilizes forms on the Internet for students to post their data, or perhaps you design a "scavenger hunt" of science content questions that student teams must answer using the World Wide Web. See the reference to "WebQuests" for ideas concerning scavenger hunts.

It is important that **before** you decide upon an Internet technology project, you check out the technology that is available to you at your school site. Remember that you do not need to have connectivity to the Internet in the classroom to do an Internet project. Check out the media center of your school to find out how many computers are connected to the Internet, and what policies are in effect regarding student access to the Internet.

Also, survey your class, and find out which students are already using the Internet, how many have actually created "web pages," and the degree of interest.

How can you use the Web site that you developed as an integral part of an Internet Technology project in the high school this semester?

Exploring Technology on the Web

You can visit several sites to begin exploring the Web. But you have done quite a bit already this year. Here for review are some sites to visit:

Dr. Hanna's Home Page: link here and then follow connections to the sites she has put up on the web.

Dr. Hassard's Home Page: link here and go to sites developed here at GSU, as well at other locations.

You might also want to explore Apple Computer's Web site, especially the Apple Research Laboratories, as well as IBM's research site, "dabbling in the digital domain." To find out how advance technology is being applied directly to science education, visit TERC, an organization in Cambridge, Massachussetts that develops Internet projects, technology tools for the classroom, and conducts research on technology applications. I also recommend that you check out the Concord Consortium Web site. The CC was formed just two years ago by some of TERC's researchers, and they are developing educational technologies for the science classroom, as well developing science education projects and reporting the results of their research.

Cool Sites for further exploration

Here are some other sites that might help you develop your Internet Project. You will find in this list actual examples of Internet projects, as well as tools to help you design your own project.

- Alice Software, which you can download free, is a powerful tool that you can use with science projects, and laboratory activities. Students can create data tables, create graphs and charts, as well as map data.
- Bill Nye the Science Guy---need we say more!
- Biology Class ONline: Modular biology curriculum for teaching at risk students.
- Blue Web'n Learning Applications: Search for specific educational tools such as Internet lesson or activity in specific science topic areas.
- Dr. Bob's Interesting Science Stuff: Enough said?
- Computers for Education: This Tennesee firm is creating Internet Web sites (for free) for every school in the United States (106,000)! Known as the American School Directory Project, you can see a fully developed web site here.
- The Exploratorium Home Page: THE Science Museum to visit!! Really.....you should visit this site.
- The Global Thinking Project: A global Internet project at GSU involving schools around the world. Check out home pages developed by students in the Georgia/Russia Exchange.
- Harris Collection of Internet Structures and Internet activities. You will find more than 200 examples of Internet projects that were developed by teachers.
- The Nevada Science Project: A journal and science related-links.
- NSTA Curriculum and Evaluation Project: A Scope Sequence and Coordination Project of the National Science Teachers

Association.

- Teaching With Technology: Planet Innovation: This site provides online tools to assist administrators and teachers in their technology implementation.
- WebQuest: A teaching paradigm using the World Wide Web. Students use the Internet for not only knowledge acquisition and integration, but for analysis and synthesis and the design of Web pages.
- Zooary: Pictures and information about animals, suggestions to help teachers set up a classroom zoo. A DeKalb County science teacher!

Developing Your Project

A good Internet project should be based on the goals of your science curriculum. The technology project that you design should NOT be viewed as something "extra," but rather as an integral part of your lesson plan or unit plan. So as you explore sites on the Internet, have the goals of your science lesson plans in mind, and think in terms of integrating technology into the teaching of science. Refer to the Internet Book (Using the Internet as a Science Teaching Tool, Hassard, 1998) that we used this Summer for ideas, lesson plans, and other ideas.

Evaluating Your Project

How successful was your project in helping your achieve the goals of the lesson or unit? What was the reaction of the students to the project? How did your peers, mentors and instructors react to your project? What changes would you make in your project if you were to use it again?

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TEEMS Spring Semester 1999

Internship Evaluation Form

Name:_____Date:_____

Reflective Journal	Poor	Fair	Good	Outstanding
Organization	1	2	3	4
Consistent documentation	1	2	3	4
Creativity	1	2	3	4
Demonstrates Growth	1	2	3	4

Comments:

Internship Feedback & Evaluation	• Comments	• Assessment
Contract		
Lesson Plans		
Practicum Evaluation Form (completed by your mentor		

Projects	Poor	Fair	Good	Outstanding
Science Mini-Unit	2	4	6	8
Lesson Planning Project	1	2	3	4
Technology Project	1	2	3	4
Assessment Project	1	2	3	4

Comments:

Portfolio: Overall	Poor	Fair	Good	Outstanding
Organization	1	2	3	4
Reflections	1	2	3	4
Creativity	1	2	3	4
Completeness	1	2	3	4

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Portfolio Elements	Poor	Fair	Good	Outstanding
Planning	1	2	3	4
Instruction	1	2	3	4
Evaluation	1	2	3	4
Management (Leadership)	1	2	3	4
Science Knowledge	1	2	3	4
Professionalism	1	2	3	4

Class Participation	Poor	Fair	Good	Outstanding
Participation/Attendance	1	2	3	4

Synthesis	Poor	Fair	Good	Outstanding
Overall Assessment of Your Work	1	2	3	4

Comments:

TOTAL POINTS :_____

Final Grade:_____

Instructor:_____Date:_____

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Contract for Practicum in High Schools

TEEMS Science Program-----Spring Semester1999

TEEMS Interns Should:

A. Preliminary Actions

_____1. Read the teacherÕs handbook of school rules and system policies

_____2. Read about and discuss the Science DepartmentÕs policies and safety procedures, with special emphasis on laboratory work.

_____3. Examine resources for teaching science including curriculum guides, texts, supplementary materials, media and technology materials including computers and Internet connectivity, software and science equipment.

_____4. Visit other science classrooms and other subject area facilities.

5. Visit and interact with personnel in:

- _____the media center/media specialist

  _____the science department including the dept. head

  _____the counseling department

  _____the principal/assistant principals

  _____the lunch room staff

B. Actions in the Science Classroom

_____1. Keep a "record" of all lesson plans

_____2. Teach and/or team teach with your mentor as many science classes as possible.

_____3. Teach your mentorÕs full morning load for a two-week period.

_____4. Design, implement and evaluate a science technology project.

_____5. Participate in tutorial or small group teaching.

_____6. Identify techniques to reinforce acceptable student behavior

_____7. Compile a "log" of hints for teaching supplied by the mentor teacher.

_____8. Identify effective strategies for time management.

_____9. Discuss safety issues with your mentor teacher.

_____10. Grade papers and keep the roll.

_____11. Develop assessment measures with assistance of your mentor.

_____12. Develop and carryout laboratory activities.

_____13. Discuss routines of teaching:

- _____beginning of class

  _____rules of student behavior

  _____collecting and grading homework

  _____ending class

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C. Professional Science Teacher Activities

_____1. Observe teachers in other classes and departments.

_____2. Examine the curriculum for the high school science program.

_____3. Find out about teacher and student support services provided by the school.

_____4. Investigate teacher activities in extra-curricular school committees or clubs.

_____5. Participate in science department meetings and/or teacher workdays.

_____6. Observe a parent-teacher conference.

_____7. Be on time.

_____8. Dress professionally

D. Additional Goals

The Intern has successfully completed or demonstrated each of item initialed above.

Mentor Teacher_____Date_____

TEEMS Intern _____Date_____

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TEEMS Questionnaires

TEEMS

Questionnaire

I.D. (Last four #'s of your social security):_____Male____Female____
Highest Degree Held: Bachelors_____Masters_____Doctorate_____

1. What are two or three ideas about science teaching that changed as a result of your participation in the TEEMS Summer Institute?

2. What is constructivist science teaching (in your own words)?

3. To what extent do you anticipate being able to implement a constructivist approach to science teaching in the middle school this term?

4. What are some of the issues or problems that you anticipate having to deal with while you are participating in the middle school practicum this term?

TEEMS: Science Education
Questionnaire
April 1999

Dear TEEMS Participants: I am asking you to take some time and complete this questionnaire to help us evaluate the TEEMS program from your point of view. I hope that the questions enable you to review the program and help you reflect on your TEEMS' experiences. Thank you very much.

I.D. (Last four #'s of your social security number):_____Female_____Male_____

Highest Degree Held (Circle): Bachelors; Masters; Doctorate

Science Major Area (Circle): Biology, Chemistry, Earth Science, Physics, Other (identify):_____

A. Opinions about your experiences

1. Three major experiences have characterized your involvement in the TEEMS program. How would you rate each of the following experiences?

	Low						High
a. The Summer Institute	1	2	3	4	5	6	7
b. The Middle School Internship Grade & subject of your internship: _____	1	2	3	4	5	6	7
c. The High School Internship Subject(s) of your internship: _____	1	2	3	4	5	6	7
d. Your experience as a TEEMS member overall.	1	2	3	4	5	6	7

Comments:

2. What activities in the TEEMS program were most beneficial and effective for you taking into consideration the philosophy of TEEMS as well as your anticipation of entering the teaching profession in the Fall of 1999?

a. The "Ozone Project" with students during the Summer Institute	1	2	3	4	5	6	7

b. The "Reflective Teaching Episodes during the Summer Institute.	1	2	3	4	5	6	7
c. The Journal or Log which you kept throughout the year.	1	2	3	4	5	6	7
d. The Portfolio that you developed during the Summer Institute.	1	2	3	4	5	6	7
e. The Professional Portfolio developed Fall and Spring.	1	2	3	4	5	6	7
f. Creating and posting on the Net fuzzy situations.	1	2	3	4	5	6	7
g. The Windows research project during the Middle School internship.	1	2	3	4	5	6	7
h. Development of the Science Tool Kit.	1	2	3	4	5	6	7
i. Developing a science teaching unit during the Summer	1	2	3	4	5	6	7
j. Developing a science teaching unit during the Spring semester.	1	2	3	4	5	6	7
k. Developing your professional web site during the Fall semester	1	2	3	4	5	6	7

Comments:

3. In your opinion, how effective were Internet and other technology tools used in the TEEMS program?

a. The Webct Bulletin Board.	1	2	3	4	5	6	7
b. The Webct e-mail function.	1	2	3	4	5	6	7
c. Developing your own website.	1	2	3	4	5	6	7

d. Using Internet tools in the middle school internship. 1 2 3 4 5 6 7

e. Using Internet tools in the high school internship 1 2 3 4 5 6 7

f. Developing and carrying out a technology project during the high school internship. 1 2 3 4 5 6 7
What project did you develop?
_____

Comments:

4. As you developed your professional portfolio, we asked you to reflect upon six areas of professional teaching development. What progress have you made in these areas? For each area, look back and assess your self initially and then assess where you are now in your development.

2. Planning
   Initially 1 2 3 4 5 6 7
   Now 1 2 3 4 5 6 7

3. Instruction
   Initially 1 2 3 4 5 6 7
   Now 1 2 3 4 5 6 7

4. Evaluation
   Initially 1 2 3 4 5 6 7
   Now 1 2 3 4 5 6 7

5. Classroom Mangement and Leadership
   Initially 1 2 3 4 5 6 7
   Now 1 2 3 4 5 6 7

6. Science Knowledge
   Initially 1 2 3 4 5 6 7
   Now 1 2 3 4 5 6 7

7. Professionalism
   Initially 1 2 3 4 5 6 7
   Now 1 2 3 4 5 6 7

Comments:

5. Core Teaching Abilities. During the TEEMS program you participated in activities designed to help you develop a number of core teaching abilities or models of teaching. Based on your middle and high school internships, how would you rate yourself as far as your ability to employ these models of teaching in your repertoire of teaching abilities?

a. Cooperative Learning	1	2	3	4	5	6	7
b. Direct-Interactive Teaching	1	2	3	4	5	6	7
c. Constructivist Model (four stage approach, e.g invitation, exploration, explanation, taking action)	1	2	3	4	5	6	7
d. Discussion Abilities	1	2	3	4	5	6	7
e. Presentation Abilities	1	2	3	4	5	6	7

Comments:

B. Reflecting upon your TEEMS Experiences

1. What are two or three ideas about science teaching that changed as a result of your TEEMS experience?

2. What in your opinion is contructivist science teaching?

3. To what extent were you able to implement a constructivist approach to science teaching in your internship experiences this year?

4. To what extent do you think you will be able to implement a constructivist approach to science teaching in your first year of teaching?

5. What "worked" for you during your internships. Jot down several pedagogical strategies that worked for you and elaborate on one or two of them explaining why they did.

6. What is the most important impression you have of your TEEMS experience?

Thank you for taking the time to complete this questionnaire. Please return it to Jack Hassard.